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**ECONOMIC ASPECTS OF TRANSPORTATION  
AFFECTING A COOPERATIVE FERTILIZER PROGRAM  
IN THE NORTH CENTRAL STATES**

By

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COOPERATIVE RESEARCH AND SERVICE DIVISION

A study conducted with funds provided  
by the Research and Marketing Act

UNITED STATES DEPARTMENT OF AGRICULTURE  
FARM CREDIT ADMINISTRATION  
WASHINGTON 25, D. C.  
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## FOREWORD

Fertilizer manufacturing and distributing by regional purchasing cooperatives in the North Central States has grown significantly during the past decade and especially since the end of World War II. By April 1951, a total of 17 regional associations were operating 9 rock phosphate acidulating plants and 29 fertilizer mixing plants. In addition, plans were being formulated for further expanding fertilizer output and services for farmer members. This region uses almost one-fourth of the Nation's annual fertilizer requirements.

This report relates to economic aspects of a study of transportation costs requested by farmers' cooperatives in the North Central States for the further development of their fertilizer manufacturing program. It is designed to: (1) Assist cooperatives in planning their current fertilizer program so they may make their maximum contribution to the defense effort, and (2) provide basic data with which to relate transportation costs and other long-run problems in future expansion of fertilizer manufacturing and distributing programs.

In this connection, general information is developed on the role of cooperatives in the commercial fertilizer industry of the region and their position with reference to procurement, manufacturing, and distribution. Consideration also is given to obtaining data related to transportation of raw materials and processed goods, to the seasonal pattern of fertilizer movement, to the kinds of fertilizer, and to other factors in transportation economics which are important to the defense effort and to planning present and future fertilizer programs of regional purchasing cooperatives.

## SUMMARY

Regional purchasing cooperatives accounted for approximately one-seventh of the fertilizer materials shipped to North Central States during 1949. Three-fourths of these shipments included high analysis fertilizer mixtures and one-fourth was made up of separate fertilizer materials exclusive of rock phosphate.

Cooperatives are leading the industry in average number of plant food units per ton of fertilizer mixtures shipped in the region.

In a continuous program of expansion to meet the increased farmer demand for fertilizers, these cooperatives individually and jointly have (1) acquired or built 29 mixing plants and 9 plants for acidulating superphosphate, (2) formed an overhead organization for joint procuring of raw materials, (3) coordinated some of their research, and (4) taken the first steps toward a contemplated program for developing phosphate deposits in the West.

Plans for present and short-run cooperative fertilizer activities are predicated on efficient use of available fertilizer supplies and the greatest possible contribution to the defense effort.

Long-range planning includes steps which call for low-cost, high-analysis plant food in the form most needed by farmer patrons for soil improvement and best suited to efficient handling. In this connection, cooperatives are studying transportation and economic factors which will determine: (1) Location of new plant facilities, (2) the extent to which they should integrate their operations to include mining-to-distribution activities, and (3) their ability to adapt to technological changes that will affect policies and methods of procuring raw materials, efficient manufacturing processes, economical storage, and the most advantageous methods of shipping fertilizer.



# ECONOMIC ASPECTS OF TRANSPORTATION AFFECTING A COOPERATIVE FERTILIZER PROGRAM IN THE NORTH CENTRAL STATES

By

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Farmers in the North Central States<sup>1</sup> have greatly increased their use of fertilizer mixtures and separate fertilizer materials during the past few years. In keeping abreast of this trend, regional purchasing cooperatives have built or acquired rock phosphate acidulating plants and fertilizer mixing plants to serve their members and have developed comprehensive programs for distributing plant food (figure 1). Although present manufacturing facilities are both individually and jointly operated, these cooperatives are making long-range plans for joint manufacturing facilities of considerable size. Important in this future planning, both from the standpoint of food and fiber needs for national defense and plant food requirements, is a contemplated program for developing phosphate deposits in Idaho to supplement present sources of phosphatic materials.

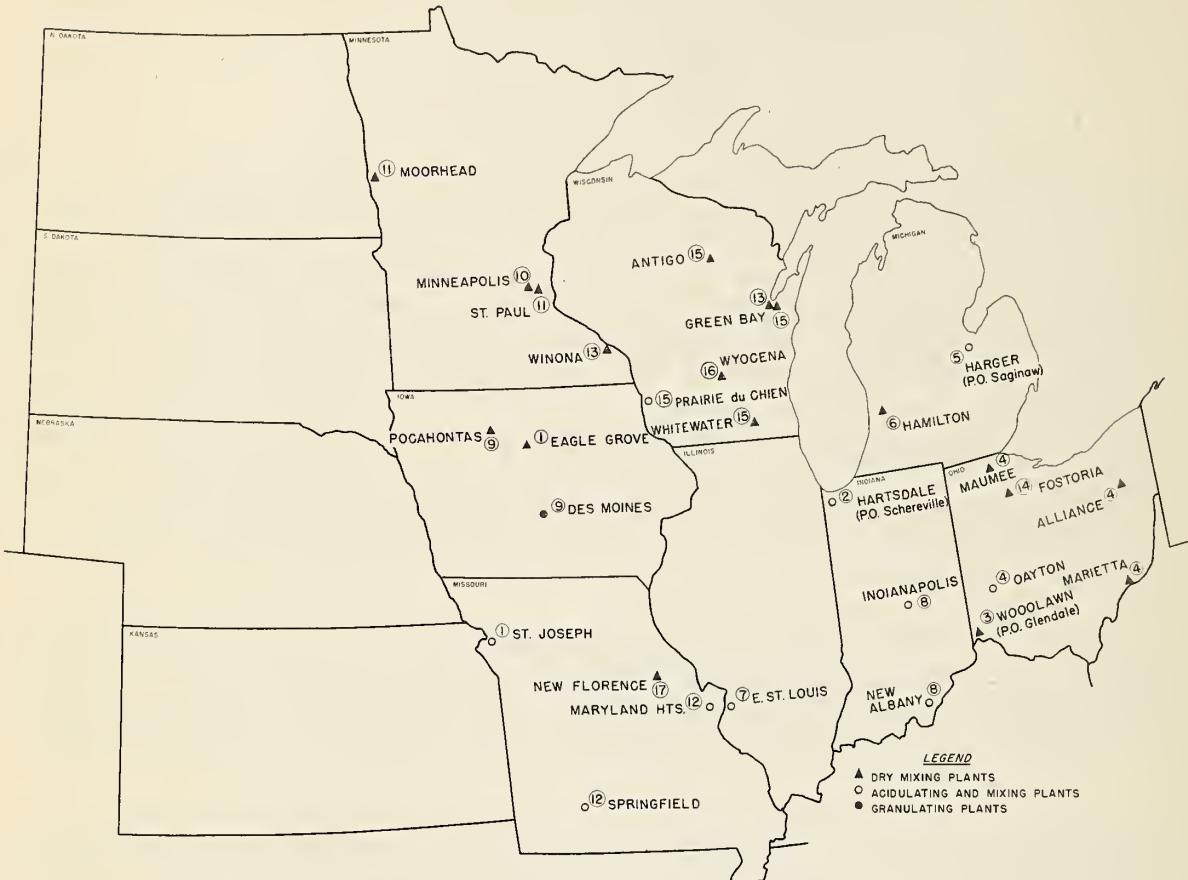
In formulating these plans and in developing a sound fertilizer program, cooperatives need freight rate information and analyses of all economic data related in any way to transportation. Sound decisions can be reached only when each factor related to the project has been analyzed.

Two previous preliminary reports have dealt specifically with carload rail freight rates on fertilizer ingredients and have presented basic information on the movement of plant food materials. Both these reports were made with Research and Marketing Act funds. A report on manufacturing costs for cooperative fertilizer plants in the North Central States, 1949, was made in February 1951. Also, a study of the layout and operations of fertilizer plants has been carried on in cooperation with the Agricultural Engineering Group of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

*NOTE: The writer wishes to express appreciation to cooperatives in the North Central States for furnishing information included in this report, and to the following colleagues in the Cooperative Research and Service Division of the Farm Credit Administration - Leonard N. Conyers, Transportation Section, and Martin A. Abrahamsen, Purchasing Section, who collaborated in all phases of the study; Joseph G. Knapp, Associate Chief, and Eugene Grab, Agricultural Engineer, for reviewing the manuscript and offering suggestions; and Michael S. Gartska, Statistical Section, who assisted with the statistical tabulations. Valuable assistance was provided by Kenneth D. Jacob, John O. Hardesty, and Arnon L. Mehring, Bureau of Plant Industry, Agricultural Research Administration; Lewis G. Porter, Production and Marketing Administration; and Roscoe E. Bell, U. S. Department of Interior.*

<sup>1</sup>In this report the term "North Central States" includes the following States: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

**FIGURE 1**  
**COOPERATIVE FERTILIZER PLANTS IN**  
**THE NORTH CENTRAL AREA**  
**APRIL 1, 1951**



COOPERATIVE ASSOCIATIONS OPERATING FERTILIZER PLANTS SHOWN ON MAP

(1) CONSUMERS COOPERATIVE ASSN., (HO KANSAS CITY, MO)	(6) HAMILTON FARM BUREAU COOP, INC., (HO HAMILTON, MICH.)	(11) MINNESOTA FARM BUREAU SERVICE CO., (HO. ST. PAUL, MINN.)
(2) COOPERATIVE PLANT FOODS, INC., (HO INDIANAPOLIS, IND.)	(7) ILLINOIS FARM SUPPLY CO., (HO CHICAGO, ILL.)	(12) MISSOURI FARMERS ASSOCIATION, INC., (HO. COLUMBIA, MO.)
(3) FARM BUREAU CHEMICAL COOP, INC., (FARM BUREAU COOPERATIVE ASSN., INC., HO COLUMBUS, OHIO)	(8) INDIANA FARM BUREAU COOPERATIVE ASSN., INC., (HO INDIANAPOLIS, IND.)	(13) NORTHWEST COOPERATIVE MILLS, INC., (HO. ST. PAUL, MINN.)
(4) FARM BUREAU COOPERATIVE ASSN., INC., (HO COLUMBUS, OHIO)	(9) IOWA PLANT FOODS CO., (HO. DES MOINES, IOWA)	(14) OHIO FARMERS GRAIN & SUPPLY ASSN., (HO. FOSTORIA, OHIO)
(5) FARM BUREAU SERVICE, INC., (HO LANSING, MICH.)	(10) LAND O'LAKE CREAMERIES, INC., (HO. MINNEAPOLIS, MINN.)	(15) WISCONSIN COOPERATIVE FARM PLANT FOODS (HO. MADISON, WISC.)

**NOTE:**  
 NUMBER OF COOPERATIVE FERTILIZER ASSN. HEADQUARTERS -- 17  
 NUMBER OF COOPERATIVE FERTILIZER PLANTS----- 29

## OBJECTIVES

This part of the over-all study is presented to assist cooperatives in planning their current fertilizer program so they can make a maximum contribution to the defense effort. It provides basic economic data with which they may relate transportation costs and other long-run problems in their future expansion of fertilizer manufacturing and distributing facilities.

The objectives of this report are:

1. To describe the general fertilizer operations of regional cooperatives in the North Central States, giving attention to procurement, manufacturing, and distribution;
2. To present economic data showing the role of cooperatives in the fertilizer industry of the region;
3. To provide statistical information related to transportation problems encountered in procuring raw materials used in manufacturing fertilizer; and
4. To bring into focus the major factors in transportation economics that need to be kept in mind (a) for a joint program of fertilizer operation, (b) for present defense needs, and (c) for long-run cooperative planning.

## METHOD OF STUDY

Information for this study was obtained by personal interviews with officials of cooperatives in the North Central States which either manufacture or distribute fertilizer mixtures or both and also handle separate fertilizer materials. Related economic, agronomic, and transportation information also were obtained from other interested agencies, including Land Grant colleges, farm organizations, banks for cooperatives, State councils of cooperatives, and State departments of agriculture.

Statistics on total shipments of fertilizer materials in the North Central area and the continental United States are from figures compiled by the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture.

## PROCUREMENT AND MANUFACTURING

Detailed information was gathered on procurement of raw materials and manufacturing fertilizer mixtures and superphosphate for the calendar year 1949. Because of varying methods of accounting and different fiscal year endings, these data were obtained on a monthly basis in order to enhance uniformity. This procedure also made it possible to include all new plants which first came into production during the year 1949. For the year 1948 information was requested only for tonnages manufactured.

Fertilizer plants on which complete or partial procurement and manufacturing data were received included 9 superphosphate acidulating plants and 23 mixing operations (appendix table 1). Among the acidulating plants, 8 were owned solely by individual regional purchasing associations and one was owned jointly by 3 organizations. The 23 mixing plants included 16 owned solely by individual regionals, 4 owned jointly by regionals, and 3 operations owned by local cooperatives serving a small area. One plant was owned by regionals which also had sole ownership of other facilities; 3 were owned jointly by associations with no outright ownership of individual plants.

These 3 local operations manufactured a combined tonnage of less than 3,000 for the year 1949. Two of them have dry mixing facilities, but the third utilizes space in a fruit packing building during the off-season for mixing grades required by a small specialty crop area. Although the latter operation is counted as a separate facility for this report, it is not shown as a mixing plant in figure 1.

A granulation plant which began operations during December 1949 was not included in the survey.

#### DISTRIBUTION

Insofar as figures were available, complete data were collected on wholesale distribution of fertilizer mixtures and separate fertilizer materials by cooperatives in the North Central States for the 10-year period 1940-49. Such information included all materials shipped through regional distribution programs regardless of original source of manufacture. Special attention was given to data showing kinds of fertilizer distributed and the seasonal pattern of shipments. For the year 1949 monthly data were secured. Cooperatives providing the distribution information included 16 regional associations and 4 locals (appendix table 2). Of this number 3 regionals were affiliated with manufacturing only on a joint basis with other associations; 2 regionals and 1 local had programs of distribution only; and 1 regional had just begun to operate a granulation plant.

#### GROWTH OF COOPERATIVE FERTILIZER PROGRAMS IN NORTH CENTRAL STATES

##### EARLY PROCUREMENT

Distributing fertilizer cooperatively began in the North Central States in 1921 as a result of steps taken by Farm Bureau leaders. The fertilizer materials were purchased from Southern plants because manufacturers in the North Central region had entered into an agreement not to sell to the Farm Bureau supply cooperatives.

In the "Report of the Federal Trade Commission on the Fertilizer Industry," Senate Document No. 347, dated March 3, 1923, this agreement is discussed as follows:

"In certain sections unfair methods, such as the use of special brands and the sale of goods to farmers already under contract to buy from the

farm organizations, were used by the manufacturers in opposing cooperative buying, and in 1921 an agreement was entered into by the manufacturers at Cincinnati not to sell such organizations."

In the middle twenties cooperative tonnages reached large proportions as the result of contracts entered into with the Tennessee Copper and Chemical Corporation of Copper Hill, Tennessee. Because State legislation required trapping or suppression of sulphur fumes, this copper mining corporation sought some method of disposing of 1,000 tons of sulphuric acid daily. The opportunity for mutual benefits resulted in an agreement between the Tennessee Copper and Chemical Corporation and Farm Bureau Cooperatives of Indiana, Michigan, and Ohio which provided for: (1) The copper company to build and buy plants to manufacture fertilizer; (2) the Farm Bureau cooperatives to help farmers organize to buy fertilizer; (3) the published price of cooperatively distributed fertilizer never to be higher than the price published by the leading companies; and (4) the savings resulting from large volume manufacturing and distributing should accrue as patronage dividends to the farmers purchasing fertilizer.

This arrangement worked satisfactorily for several years, but cooperatives finally decided that their fertilizer programs could be strengthened and their members better served by manufacturing fertilizer mixtures and superphosphate in farmer-owned and controlled plants.

One association, with an approximate plant investment of \$250,000, estimates that their farmer-members were saved \$1,000,000 on fertilizer purchased cooperatively during 1941. For 1948 this organization had \$450,000 invested in fertilizer plants and estimated their members' savings on fertilizer to be \$2,600,000 for the year.

#### MANUFACTURING PLANTS ACQUIRED

##### Mixing

The first cooperative fertilizer was manufactured in the North Central States in 1932 when one regional purchasing association and one local began mixing operations on a small scale. Additional mixing plants came into operation in 1935 and 1938, and the year 1940 ushered in a decade of rapid and continued expansion. By 1949 there were 23 individually or jointly-owned cooperative fertilizer mixing operations in these States with an annual capacity rated at over 700,000 short tons of plant food mixtures. As shown in table A the 5-year period 1945-49 accounted for 48 percent of the cumulative mixing capacity of these plants. By April 1, 1951, five additional mixing plants had been built or acquired by cooperatives (figure 1).

##### Acidulating

The first acidulating of rock phosphate by a cooperative in the North Central region was in 1944. By 1949 there were 9 plants with a combined output rated at approximately 270,000 short tons of superphosphate

Table A. - Fertilizer plants owned by cooperatives in North Central States, year acquired, and rated capacity of facilities as of 1949

Year	Plants acquired or built		Capacity, rated as of 1949, of same or improved facilities	
	Mixing	Acidulating	Mixing	Acidulating
	Number			
1932-----	<sup>1</sup> 2	-	1	-
1935-----	<sup>1</sup> 1	-	-	-
1938 <sup>2</sup> -----	1	-	4	-
1940-----	4	-	29	-
1941-----	1	-	6	-
1942-----	1	-	1	-
1944-----	2	1	11	7
1945-----	1	1	4	15
1946-----	3	1	15	11
1947-----	1	-	4	-
1948-----	<sup>3</sup> 4	3	11	46
1949 <sup>4</sup> -----	4	3	14	21
Total-----	<sup>5</sup> 25	9	100	100
Tons-----			705,000	270,000

<sup>1</sup>One plant first built in 1932 was replaced by new facilities in 1944 and another plant built in 1935 was replaced in 1949.

<sup>2</sup>During this year one regional also acquired part interest in a cooperative fertilizer plant located at Baltimore, Md.

<sup>3</sup>Includes one minor mixing operation for specialty crop area - not a fertilizer plant.

<sup>4</sup>One regional cooperative also constructed a mixing plant in a State adjoining the West North Central area.

<sup>5</sup>Because of two replacements only 23 plants were in operation in 1949.

(18-20% P<sub>2</sub>O<sub>5</sub>) annually. As indicated in table A, the greatest increase in acidulating capacity, 46 percent, was made in 1948. Ninety-three percent of the 1949 rated output resulted from new plants constructed during the 5-year period 1945-49.

#### JOINT PROCUREMENT OF RAW MATERIALS

Procuring raw materials jointly for manufacturing fertilizer cooperatively in the North Central States began in 1943 when purchasing cooperatives of the South and the Midwest formed Associated Cooperatives, Inc. Through this organization TVA manufactured fertilizer materials were distributed to cooperative plants in the North Central region. In a further move to procure materials jointly, the major North Central regional cooperatives united in 1946 to form an overhead purchasing agency called Central Farmers Fertilizer Company. This step was taken, among other reasons, because of postwar procurement problems, shortages

of some raw materials, greatly expanding volume of output from new facilities, and the need to coordinate financing in projected long-run cooperative fertilizer programs.

A similar step was taken by Northwest cooperatives and general State farm organizations which formed Western Fertilizer Association in 1947. Membership includes all the regional or State-wide farmer cooperatives in the States of Washington, Oregon, Idaho, and Utah, as well as the Washington Grange and the Idaho and Utah Farm Bureaus. This association possesses a lease granting mineral rights on 1,500 acres of phosphate deposits in Southeast Idaho. These deposits are within a few miles of those purchased by the Central Farmers Fertilizer Company.

According to its articles of incorporation, the following are purposes for which the Central Farmers Fertilizer Company was formed:

1. To acquire and hold mineral deposits and reserves and to manufacture plant foods and related chemicals of every kind and description and all of the ingredients and elements thereof and all of the by-products and incidental products thereof and to buy, sell, lease, otherwise acquire and deal in mines, lands, and buildings and other structures thereon and to mine, mill, and process minerals and other essential plant foods or plant food ingredients.
2. To engage in any cooperative activity for the mutual benefit of its members or patrons in connection with the production, processing, purchasing, storing, distribution, transportation, shipping, or marketing of essential plant foods and plant food ingredients.
3. To do each and everything necessary, suitable, or proper for the accomplishment of any of the purposes expressed herein, with all the powers given by the provisions of "The Agricultural Cooperative Act," approved June 21, 1923, as amended, and to do any and all things incidental to the above purposes.

In fulfilling its first purpose, Central Farmers Fertilizer Company has acquired phosphate rock deposits in Idaho and has initiated preliminary engineering activities required for eventual mining and manufacturing activities. In addition, the company has been carrying on prospecting and core-drilling operations in potash horizons of the Carlsbad, N. Mex., area.

In 1949 this agency bought fertilizer materials valued at \$6,464,917, at a net savings of \$59,042 to its 17 member cooperatives. Tonnages for the year, by commodity, were as follows:

	<u>Tons</u>
Triple superphosphate-----	82,815
Calcium metaphosphate-----	734
Ammonium nitrate-----	36,795
Nitrogen solution-----	10,291
Di calcium phosphate-----	1,740
Ammonium sulphate-----	461
Total-----	132,836

Of the total tonnage, 107,345 tons were purchased from TVA with 77.2% of TVA tonnage consisting of triple superphosphate, 20.5% ammonium nitrate, 1.6% di calcium metaphosphate, and 0.7% calcium metaphosphate.

#### RESEARCH

Research relating to manufacturing and distributing fertilizer cooperatively in the North Central region has included accounting and procedural studies on individual programs, some engineering experimentation to iron out local plant difficulties, and experiments in distributing fertilizer in bulk direct to farm fields. Cooperatives also have contributed to agronomic research, along with old line fertilizer manufacturers, as members of the Midwest Soil Improvement Committee. Various research projects on fertilizers are carried on by 10 universities in 10 Midwestern States with funds collected from the committee members on the basis of tonnages manufactured.

Of research benefit to the numerous North Central cooperatives with Farm Bureau affiliations is the American Farm Research Association formed in 1944. This organization ferrets out new developments in the work of Land Grant colleges and other research sources, agronomic and non-agronomic, and informs its members of these and their commercial practicability.

North Central cooperatives using Tennessee Valley Authority produced phosphates and nitrogen in their manufacturing contribute to a broad program of research on fertilizer use and costs. Under this arrangement the cooperatives agree that they will sell TVA phosphate fertilizer only to those persons who agree to use it on crops which are not intertilled such as pastures, meadows, and small grains, or in soil-building crop rotations, and will use their best efforts to give preference in such sales to those persons who are known to be following farming practices which are consistent with test-demonstration objectives. They promise further that such phosphate fertilizers will be sold in unmixed form and will not be used or sold for use in commercial mixtures which are guaranteed to contain nitrogen. Insofar as practicable, nitrate fertilizers originating from TVA are sold chiefly for application to the land in unmixed form.

Cooperatives have agreed further to provide and assist in the interpretation of such records and accounts as are necessary to determine the distribution costs of TVA fertilizers. This includes the purchase price paid by farmers, and the amounts of such purchase price attributable to distribution costs including transportation, taxes, tagging, registration fees, general overhead, and all other direct handling expenses. The results of these findings, in turn, are made available to cooperatives and to other manufacturers and distributors in the fertilizer industry.

Research studies made by the Cooperative Research and Service Division, Farm Credit Administration, U. S. Department of Agriculture, which have been in part or entirely related to fertilizer programs of cooperatives in the North Central region, include: "The Place of Cooperatives in the

Fertilizer Industry," Miscellaneous Report 85, May 1945; and a special report, "Manufacturing Costs as Reported for Cooperative Fertilizer Plants in the North Central States," February 1951. Another study on cooperative plants in the South was reported upon in Circular C-126, "Cooperative Manufacture and Distribution of Fertilizer by Small Regional Dry-Mix Plants," June 1941.

#### DISTRIBUTION PRACTICES

Considerable variation was found in the types of fertilizer programs carried on by regional purchasing cooperatives of the North Central area. All of these associations are of the federated type and sell plant foods at wholesale prices and only through their affiliated outlets or selling agents. However, a member of a cooperative whose farm is close to a fertilizer plant of a regional association is permitted to pick up materials at the point of manufacture, but the transaction is first cleared through the local outlet where he has membership.

In distributing separate materials which are ready for direct application to the soil, the regional cooperative usually does the ordering on a consignment or brokerage basis and the materials are shipped direct from the point of origin to the local outlet making the requisition. Mixtures contracted for by the associations and by those supplementing their own output move in a similar manner.

Bagged fertilizer constituted the greater volume of materials distributed by regional purchasing cooperatives in the North Central region during 1949. However, some experimental programs on bulk distribution of materials direct to farm fields were well underway during the year. Also under study were programs for direct application of anhydrous ammonia, and one such program was initiated during 1950.

In distributing fertilizer, 14 cooperative plants, including three with multiple facilities, estimated that rail and motor truck movements during 1949 were as follows:

<u>Percent range</u>	<u>Number of co-ops reporting movement by:</u>	
	<u>Truck</u>	<u>Rail</u>
0 - 20	3	3
21 - 40	4	3
41 - 60	4	2
61 - 80	1	5
81 - 100	2	2
	<u>14</u>	<u>14</u>

Of the proportion moved by trucks, vehicles owned by locals accounted for the largest share in the East North Central States and those owned by regionals moved the greatest volume of shipments in the West North Central area (figure 2). Farmer-owned trucks were third in importance in the Western area of the region but ranked fourth in tons handled in the Eastern area.

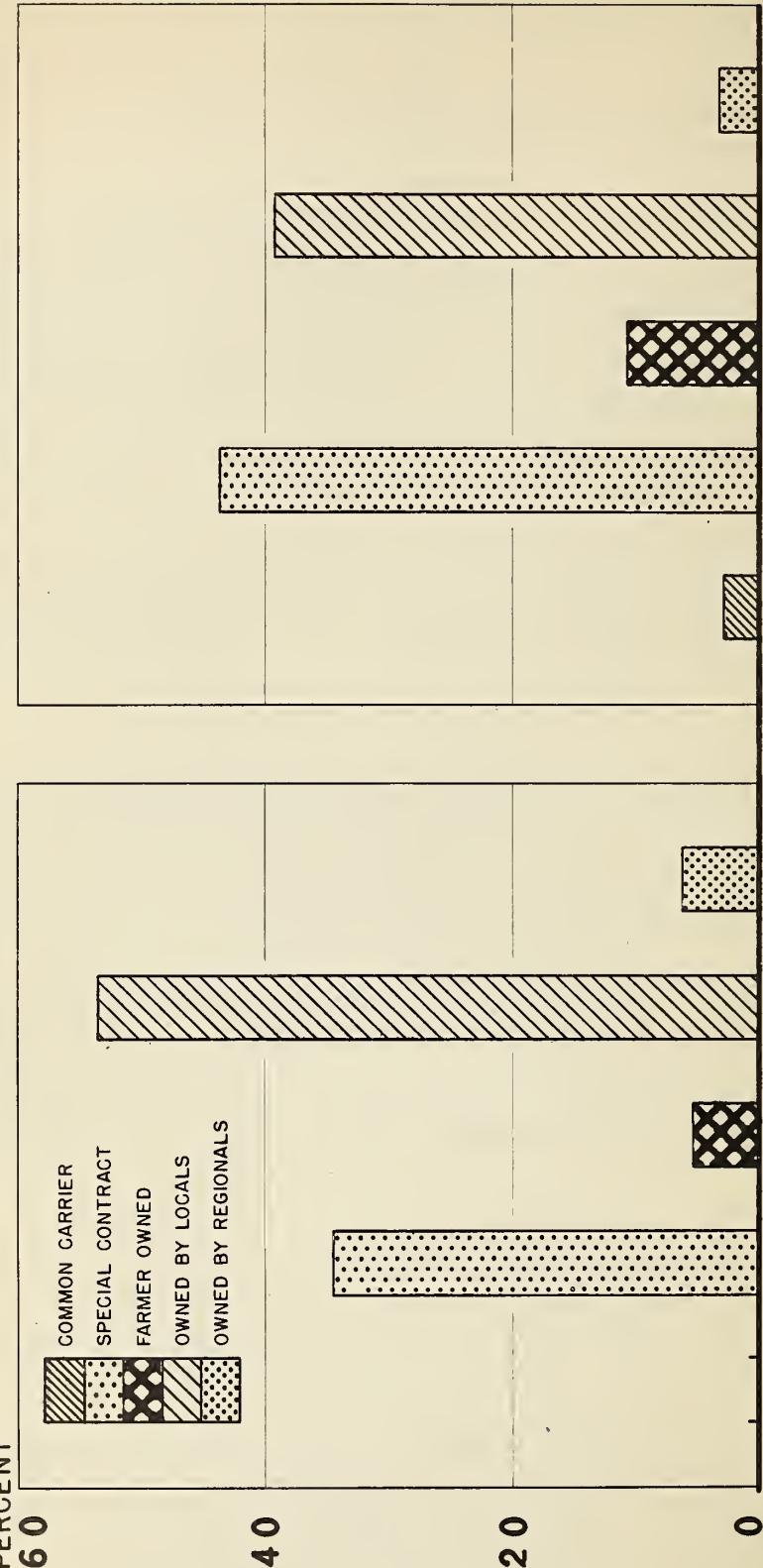
FIGURE 2

# ESTIMATED PERCENT OF FERTILIZER MOVING FROM REGIONAL CO-OP FACILITIES BY TYPES OF MOTOR TRUCK CARRIERS, NORTH CENTRAL STATES, 1949\*

EAST NORTH CENTRAL STATES  
(6 CO-OPS REPORTING)

PERCENT  
60  
40  
20  
0

COMMON CARRIER  
SPECIAL CONTRACT  
FARMER OWNED  
OWNED BY LOCALS  
OWNED BY REGIONALS



•BASED ON ESTIMATES MADE BY CO-OP PERSONNEL

Pricing policies of cooperatives in the region are very much the same as those for the industry as a whole. Cooperatives credit themselves with influencing the relatively low level of prices maintained throughout the years and cite the precedent set by them in their first fertilizer program of the early twenties.

The Federal Trade Commission in a letter of transmittal, accompanying Senate Document No. 347, dated March 3, 1932, to the President of the United States Senate, stated: "Attention is also directed to the benefits which have resulted to the farmer through cooperative buying of fertilizer which has been the most important factor in lowering the price of this important product."

### COOPERATIVE FERTILIZER MANUFACTURING

During 1949 the 23 cooperative fertilizer plants, operating in the East and West North Central States, manufactured 518,816 short tons of mixed goods, or an increase of more than 31 percent over the 1948 production (figure 3). Superphosphate manufactured by the 9 acidulating plants in 1949 totaled 222,619 short tons, an increase of 38 percent from the previous year.<sup>2</sup> Reflected in these production increases are output figures for 4 mixing and 3 acidulating plants acquired during 1949. Figure 4 shows the location of various types of plants operating in the region and of those which provided partial or complete manufacturing data.

This 2-year comparison of the growing cooperative fertilizer manufacturing program brings into focus cumulative aspects of output and procurement which have continued to characterize the new development for the past decade. The combined effect of these developments is important to North Central cooperatives in considering economic and transportation factors relating to any joint fertilizer efforts which they may undertake.

The purpose of this section is to further amplify the statistics back of these economic and transportation factors. Specific data, for the calendar year 1949, are presented to give: (1) Detailed information on cooperative mixing plants, giving special attention to incoming shipments of fertilizer ingredients, the use of such ingredients in the manufacture of mixtures, and the pattern of plant shipments; and (2) detailed information on cooperative acidulating plants, giving attention to the receipts and use of rock phosphate and sulphuric acid, the tonnages of ordinary superphosphate manufactured, and the proportion of materials transferred to mixing operations or shipped direct to outlets or both.

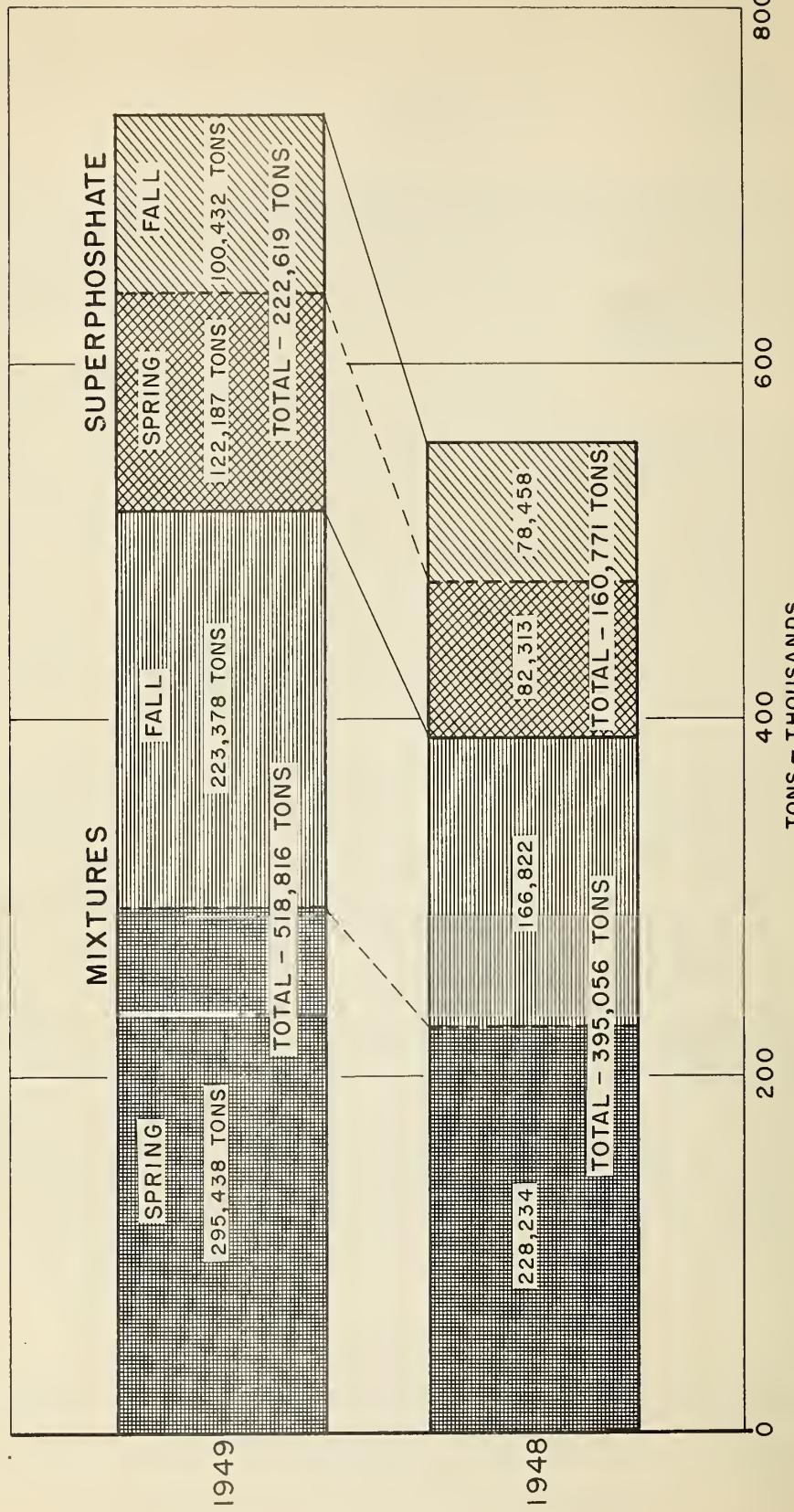
#### MIXING

##### Procurement of Ingredients

Procurement data were available for 16 fertilizer mixing plants. Included in the total are four new plants which operated for 10, 9, 7, and 6 months, respectively, during 1949. These 16 plants manufactured

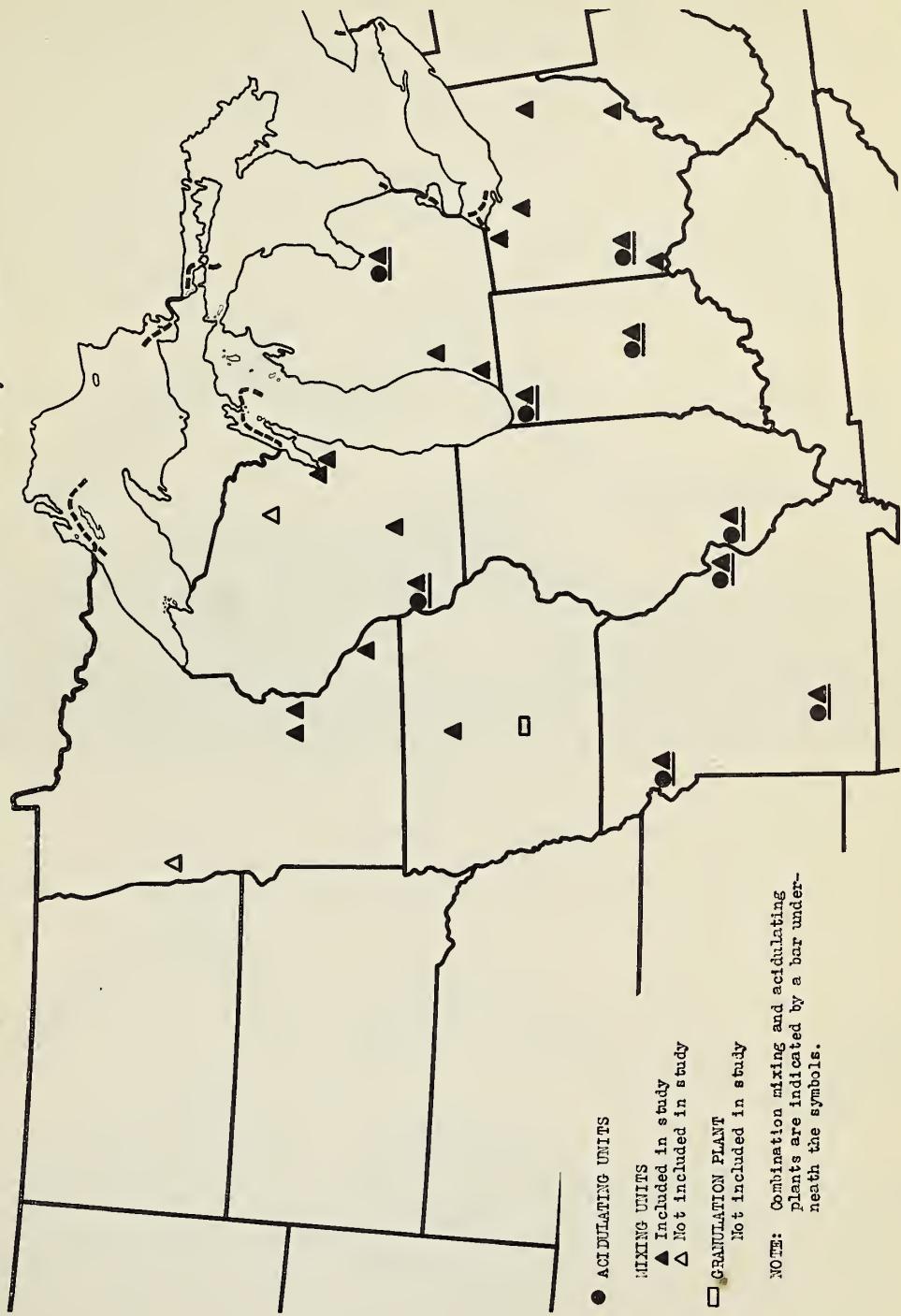
<sup>2</sup>No triple superphosphate is manufactured by cooperatives in the North Central Region.

FIGURE 3  
TONNAGES OF FERTILIZER MIXTURES AND ORDINARY SUPERPHOSPHATE  
MANUFACTURED BY PLANTS OF REGIONAL COOPERATIVES, NORTH  
CENTRAL STATES, CALENDAR YEARS 1948 AND 1949



• INCLUDES PLANTS LOCATED IN OHIO, INDIANA, ILLINOIS, MICHIGAN, WISCONSIN, MINNESOTA, IOWA AND MISSOURI.

FIGURE 4  
LOCATION OF CO-OP FERTILIZER PLANTS  
IN THE NORTH CENTRAL STATES, 1949



031007-1

approximately 73 percent of the mixtures reported by cooperatives for 1949.

Figure 5 shows the monthly quantities of the four main types of materials received for mixing. These monthly data indicate shipments received for 1949 and cannot be interpreted in the light of a seasonal pattern because: (1) Shortages which existed in some kinds of ingredients forced plants to take a greater volume of lower analysis materials and to change their production plans; (2) requirements for new plants increased the totals for the fall season, a characteristic that would appear in any year's figures as additional cooperative plants are added; and (3) the implications of new storage capacity being added to existing facilities for use beyond the 1949 fall season. Important also are incoming shipments of bags and packaging materials, as well as fuel for certain types of motor equipment, and similar items.

On a percentage basis, the 345,220 tons of incoming ingredients were reported for the year as follows:

	<u>Percent</u>
Superphosphate-----	55
Potash-----	24
Nitrogen-----	11
Conditioners, fillers, and secondary elements	<u>10</u>
Total-----	100

Of the superphosphate tonnages received, 79 percent were for Ordinary and 21 percent were Triple. Whereas all shipments of triple superphosphate originated from other manufacturers, the tonnages of ordinary superphosphate used in mixing included quantities manufactured by the cooperative acidulating plants as well as from other sources. If the volume of ordinary superphosphate indicated is adjusted to include 100 percent of cooperative mixing requirements and added to the total tonnages shipped for direct application to farm fields, it is estimated that these associations had to procure 50,000 tons from other manufacturers during 1949.<sup>3</sup>

Muriate of potash (60% analysis) accounted for almost two-thirds of the volume of potash carriers received. The other one-third was made up chiefly of manure salts, muriate of potash (40% and 50% analysis), and tobacco stems.

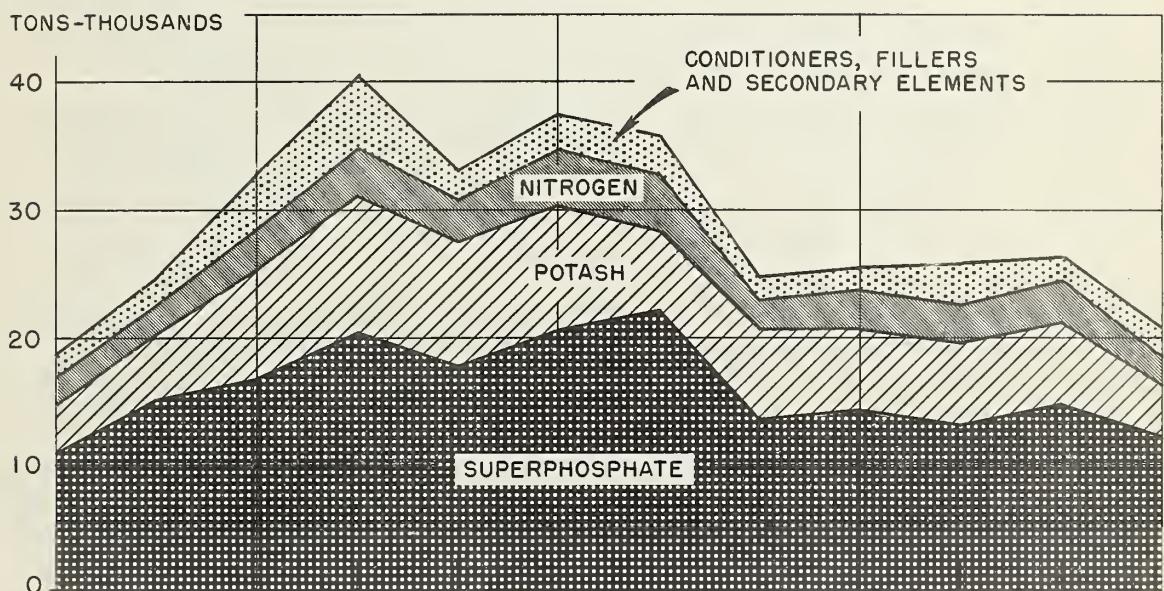
Solid nitrogen compounds and ammoniating solutions constituted the largest share of nitrogen fertilizer materials received by the 16 mixing plants, with only a few tons of nitrogen natural organics reported. Solid nitrogen compounds exceeded the solutions by about 13 percent of the total tonnage. Sand, dolomite, limestone, spent fuller's earth, and humus, in that order, made up the greater part of conditioners and fillers. For a more detailed breakdown on the above ingredients and secondary elements, see appendix tables 3, 4, and 5.

<sup>3</sup>See p. 31.

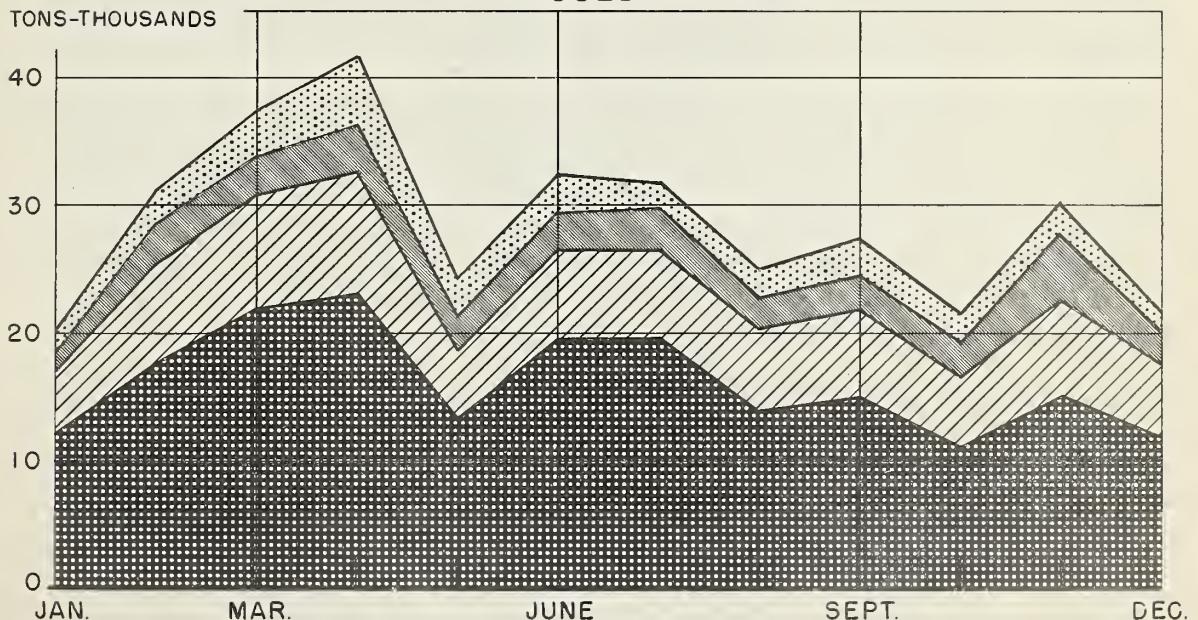
FIGURE 5

TONNAGE OF MATERIALS RECEIVED AND USED FOR  
MANUFACTURE OF FERTILIZER MIXTURES BY 16  
PLANTS OF REGIONAL COOPERATIVES, NORTH  
CENTRAL STATES, 1949\*

RECEIVED



USED



These 16 plants manufactured approximately 73 percent of the mixtures reported for 1949 by cooperatives.

If the fertilizer shipments received, shown in figure 5, are adjusted to include receipts for all cooperative mixing plants, it is estimated the total incoming ingredients would approximate 463,400 tons for 1949. In such an estimate it is assumed that comparable shipments and types of materials entered into mixing operations for the 27 percent of production not reported. This estimate of receipts for all mixing plants is divided as follows:

	<u>Estimated tonnages</u>
Nitrogen-----	51,400
Superphosphate (20% and 45%)-----	253,650
Potash-----	113,550
Conditioners, fillers, and secondary elements-----	<u>44,800</u>
Total-----	463,400

#### Use of Materials

Data presented in figure 5 also show the monthly tonnages of ingredients which went into the mixing operations of the 16 plants reporting. Appendix tables 6 and 7 give detailed information on the materials used in mixing operations.

Figure 6 is presented to show when materials were received, when mixtures were manufactured, and when plant shipments moved. Each activity is indicated as a monthly percentage of the year's total. April was the peak month for all three categories, although the peak for plant shipments was only 1 percent lower in September than in April. Plant shipments also showed the sharpest decline for any activity, with a relatively small percentage of materials moving during June, July, and November. Appendix table 8 gives a detailed comparison.

Monthly tonnages of fertilizer mixtures are shown for 20 plants in figure 7. These plants manufactured 98 percent of the total output of cooperative mixing operations for the region during 1949. By comparing the peaks in this chart with those shown for the 16 plants in figure 6, little variation is noted except for a slightly higher output in October for the larger number of plants. Appendix table 9 gives the actual or estimated tonnages reported for the 20 plants.

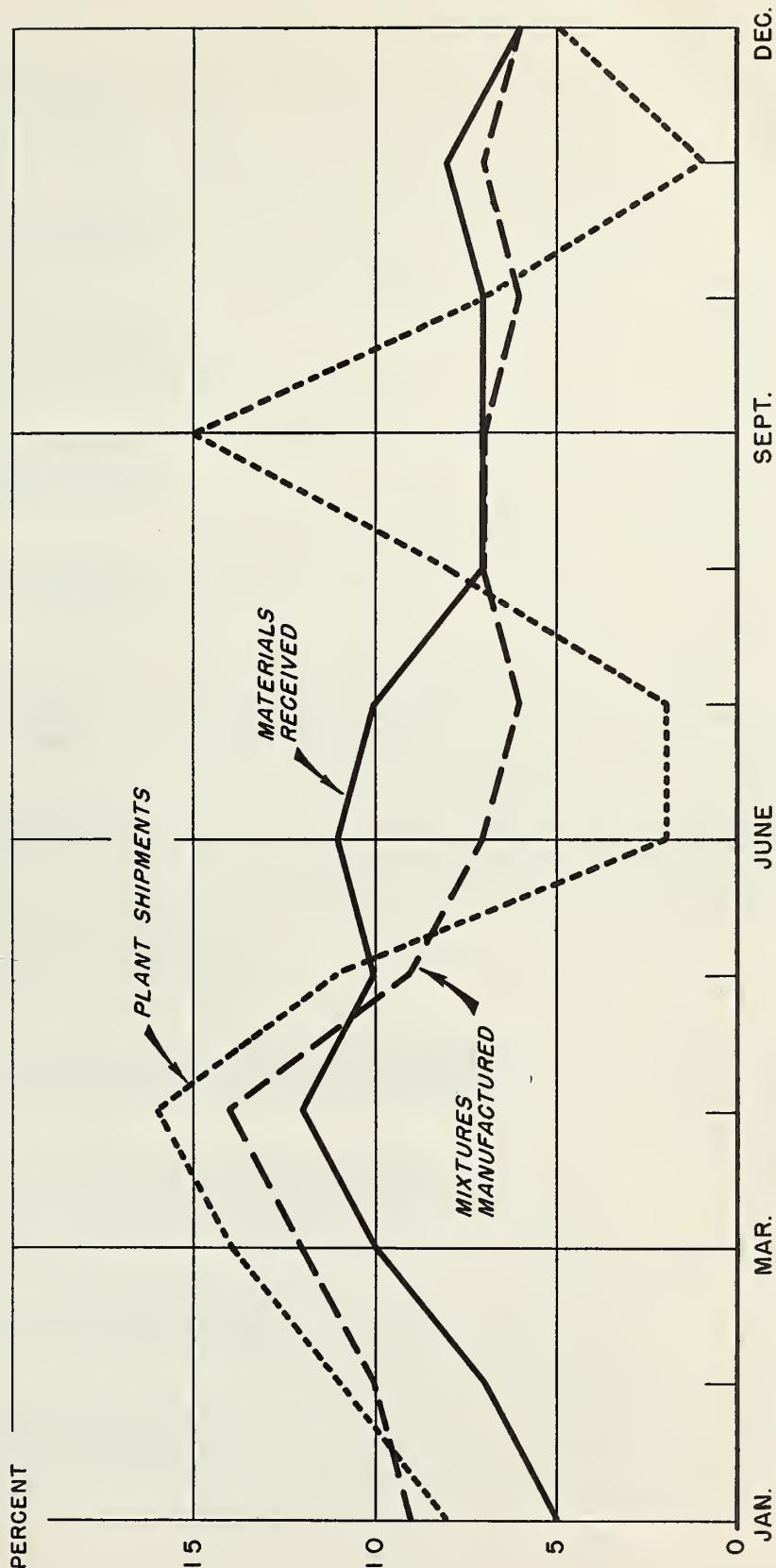
#### ACIDULATING

Data were available for 8 acidulating plants on tonnages of rock phosphate and sulphuric acid received and used for manufacturing ordinary superphosphate. These figures included information for 3 acidulating plants which operated for 10, 9, and 7 months, respectively, during 1949. The 8 plants manufactured approximately 82 percent of the ordinary superphosphate reported by cooperatives for 1949.

A graphic comparison is given in figure 8 to show monthly shipments received and quantities used. Additional details on these ingredients for acidulating are provided in appendix tables 3, 4, 5, 6, and 7.

FIGURE 6

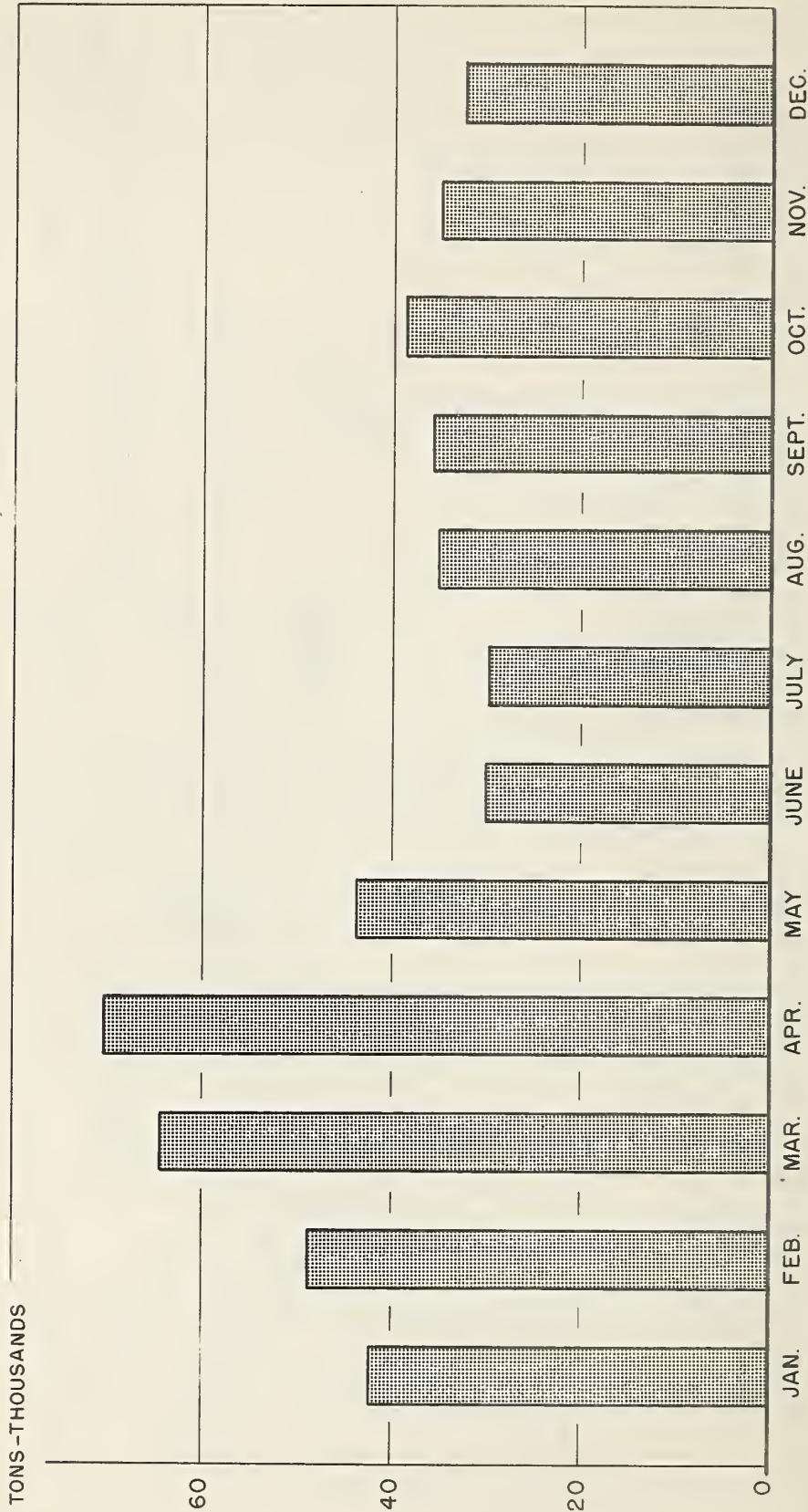
PERCENTAGE OF MATERIAL SHIPMENTS RECEIVED, FERTILIZER  
MIXTURES MANUFACTURED, AND PLANT SHIPMENTS REPORTED  
FOR 16 MIXING PLANTS OF REGIONAL COOPERATIVES  
NORTH CENTRAL STATES, 1949●



● Data represent approximately 73 percent of manufactured mixtures reported for plants of regional cooperatives.

FIGURE 7

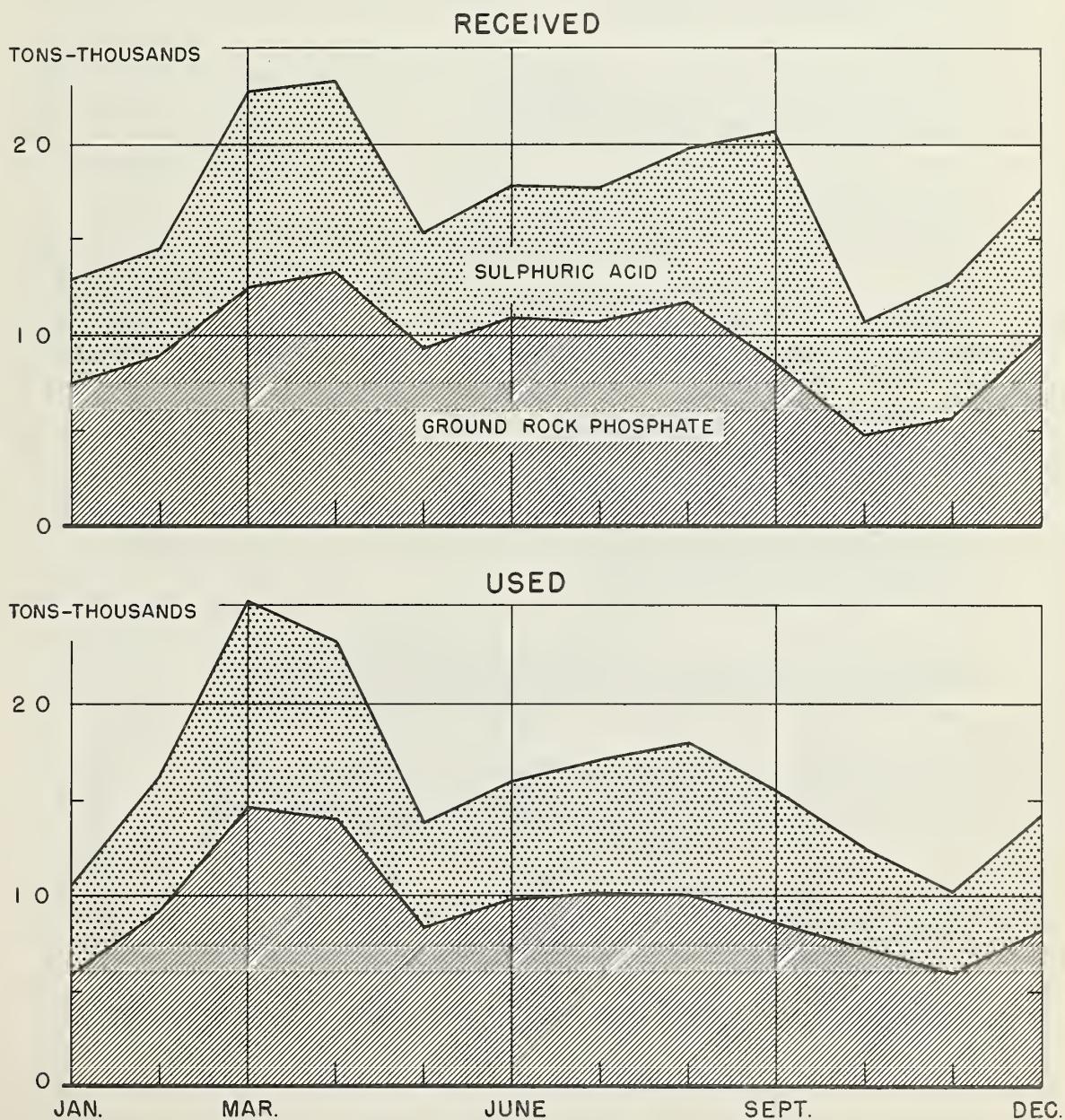
MONTHLY TONNAGES OF FERTILIZER MIXTURES MANUFACTURED  
BY 20 PLANTS OF REGIONAL COOPERATIVES  
NORTH CENTRAL STATES, 1949•



• Includes data for 98 percent of mixed tonnages manufactured cooperatively.

FIGURE 8

TONNAGES OF GROUND ROCK PHOSPHATE AND  
SULPHURIC ACID RECEIVED AND USED FOR  
MANUFACTURE OF ORDINARY SUPERPHOSPHATE  
BY 8 ACIDULATING PLANTS OF REGIONAL  
COOPERATIVES, NORTH CENTRAL STATES, 1949\*



\* These 8 plants manufactured approximately 82 percent of the ordinary superphosphate reported for 1949 by cooperatives.

If adjustments are made to include all acidulating operations, the ingredients for 1949 acidulating is estimated as follows:

	Estimated tonnage
Rock phosphate-----	138,000
Sulphuric acid-----	<u>112,000</u>
Total-----	250,000

Another 208,796 tons of rock phosphate were handled by cooperatives for direct application to farm fields, chiefly in Illinois, which would make a total rock phosphate requirement of 346,796 tons for regional cooperatives.<sup>4</sup>

The monthly distribution of superphosphate tonnages acidulated during 1949 are shown in figure 9. The rate of production ranged from a peak of almost 30,000 tons in March down to a low of slightly over 11,000 tons in November. More detailed information on acidulated tonnages is provided in appendix table 9.

Cooperative acidulating plants reported that movement of cured superphosphate was either: (1) To an adjacent mixing plant, (2) to a cooperative mixing plant located elsewhere in the region, or (3) shipped in bagged or bulk form for direct application to farm fields. Five acidulating plants provided the data shown in table B on the manner in which superphosphate of their own manufacture was disposed of each month of the calendar year 1949.

<sup>4</sup>See p. 28.

Table B. - *Method of superphosphate movement as reported by 5 cooperative acidulating plants, North Central States, by months 1949<sup>1</sup>*

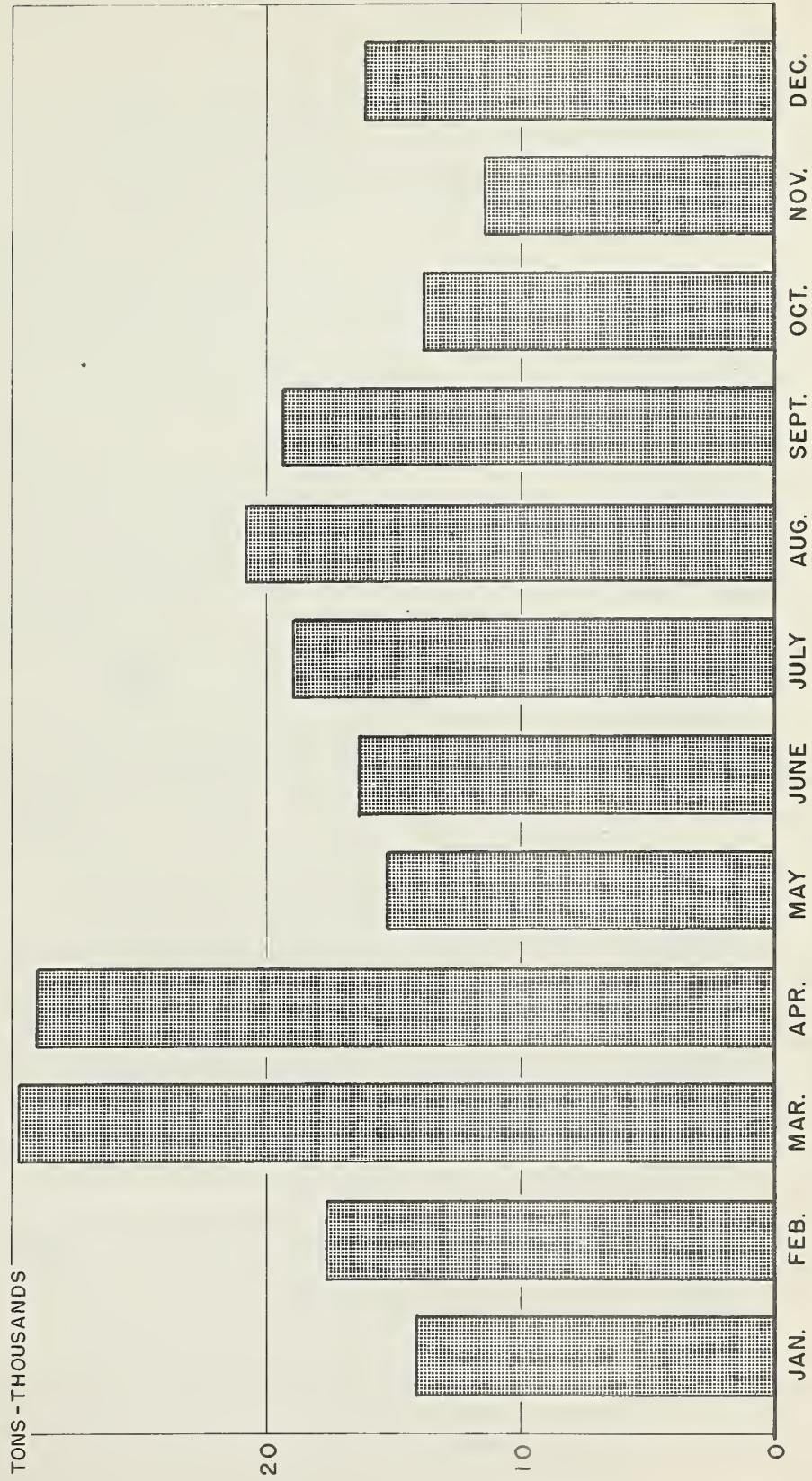
Month	Manu- factured	Total moved from plant		Distribution of total		
				Transferred to mixing	Plant shipments	
		Tons	Tons		Bagged	Bulk
January-----	9,457	10,693	7.0	77.8	17.5	4.7
February-----	13,039	13,087	8.6	70.9	17.4	11.7
March-----	21,952	24,478	16.0	61.6	24.6	13.8
April-----	20,951	22,150	14.5	51.4	28.6	20.0
May-----	11,771	11,587	7.6	66.4	11.9	21.7
June-----	15,030	11,467	7.5	77.0	4.9	18.1
July-----	11,913	11,035	7.2	60.6	3.5	35.9
August-----	12,719	11,356	7.4	63.9	11.0	25.1
September-----	9,712	11,417	7.5	65.4	14.8	19.8
October-----	7,928	7,582	5.0	65.2	16.8	18.0
November-----	6,819	10,417	6.8	65.6	7.5	26.9
December-----	10,134	7,562	4.9	67.5	10.8	21.7
Total---	151,425	152,831	100.0	64.7	16.1	19.2

<sup>1</sup>These 5 plants acidulated approximately 68 percent of the superphosphate reported for 1949 by cooperatives.

NOTE: Tons manufactured and tons moved would not be equal during a calendar year because of inventories carried over and because of the time lag for curing.

FIGURE 9

MONTHLY TONNAGES OF ORDINARY SUPERPHOSPHATE MANUFACTURED  
BY 9 ACIDULATING PLANTS OF REGIONAL COOPERATIVES  
NORTH CENTRAL STATES, CALENDAR YEAR, 1949



● PLANTS LOCATED IN OHIO, INDIANA, ILLINOIS, MICHIGAN, WISCONSIN AND MISSOURI.

## ROLE OF COOPERATIVES IN FERTILIZER DISTRIBUTION

As pointed out in a previous section, regional purchasing cooperatives of the North Central States began developing programs for distributing fertilizer almost 30-years ago. During the intervening years these farmer-owned organizations have had an important role in expanding the use of fertilizer in the region. In fulfilling that role, and in their effort to provide cheap plant food for the farmers they serve, they deemed it necessary to integrate their operations by acquiring their own mixing and acidulating plants. The locations selected were advantageous for over-all economy in manufacturing and for favorable transportation costs to areas of greatest distribution. The item of transportation in moving fertilizer has taken on more prominence with the considerable increases in freight rates during the past 10-years.

Further integration of cooperative fertilizer activities is planned in mining and processing rock phosphate to meet the growing need for phosphate materials in the North Central region. This need has become even more urgent with the defense effort and the Government's request for increased goals in food production. Such plans, whether for short- or long-run efforts, call for a study of all information relating to the past and present development of fertilizer use in these States and for an examination of the portion attributable to cooperatives. This section provides some of the information needed.

Data presented include: (1) Total fertilizer mixtures and separate materials distributed, the relative position of the region in the fertilizer industry, seasonal and yearly changes in shipments, and kinds of materials moved; and (2) statistics to show the position of cooperatives as related to the over-all data.

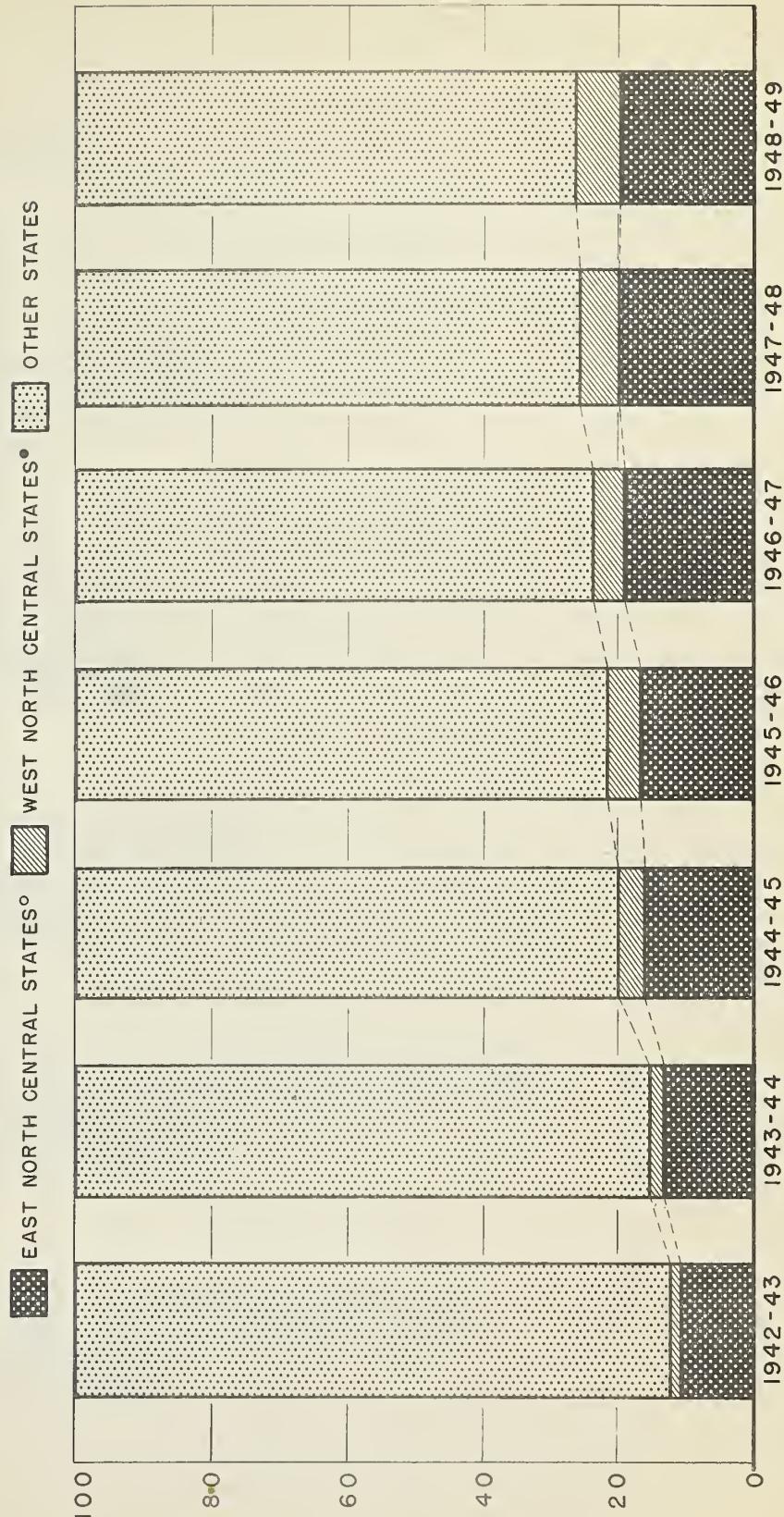
### REGIONAL DISTRIBUTION OF FERTILIZER

During the year ending June 30, 1949, farmers in the North Central States were using over one-fourth of the fertilizer materials consumed in the continental United States (figure 10). This is in contrast to a one-twelfth share for the year ending June 30, 1943. The 5 East North Central States - Ohio, Indiana, Illinois, Michigan, and Wisconsin - reported the greatest part of the regional distribution for the 1949 fiscal year or a combined total of 3,594,685 tons, which was approximately one-fifth of the 18,200,887 tons used by all farmers of the Nation. During the same 12-month period, the 7 West North Central States consumed 1,190,550 tons or 6.5 percent of the Nation's total. Appendix table 10 gives an additional breakdown on tonnages and percentages for the North Central States and the United States from the fall of 1942 through the spring of 1949.

When these increases in fertilizer used are expressed in terms of percentage change, it is the West North Central area which shows the greatest year to year progress (figure 11). During the 6 fiscal years, just prior to July 1, 1949, the yearly increases for these 7 States ranged from 15.8 percent to 74.1 percent. For the East North Central

FIGURE 10

SHIPMENT OF COMMERCIAL FERTILIZER MIXTURES AND SEPARATE MATERIALS, NORTH CENTRAL STATES AS PERCENT OF CONTINENTAL UNITED STATES, FALL 1942 THRU SPRING 1949

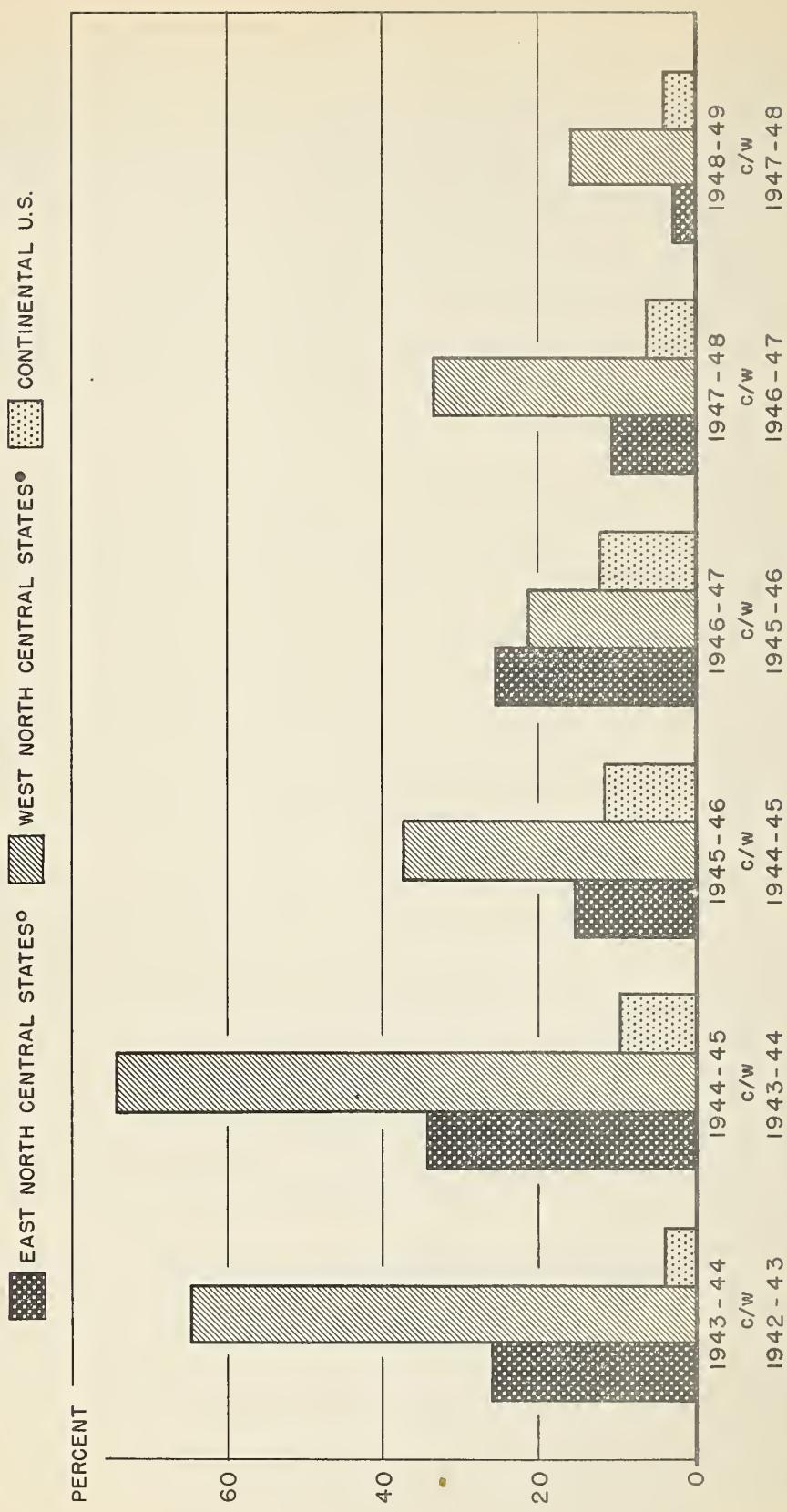


© OHIO, INDIANA, ILLINOIS, MICHIGAN AND WISCONSIN.

• MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA AND KANSAS.

FIGURE II

PERCENT CHANGE IN SHIPMENT OF FERTILIZER MIXTURES AND SEPARATE MATERIALS, NORTH CENTRAL STATES AND CONTINENTAL UNITED STATES, FALL 1942 THRU SPRING 1949



area the range of increases was from 2.7 percent to 37.5 percent. With one exception the percentage change for these two areas was greater than those for the United States as a whole. Appendix table 11 shows comparisons of the percent change.

#### Kind of Fertilizer

Mixed goods made up the greater share of fertilizer materials shipped to farmers in the North Central States during recent years (figure 12). In the year ending June 30, 1949, 72 percent of all shipments in the region were in the form of mixtures and 28 percent were separate materials. When examined on an area basis these ratios are somewhat different, with separate materials making up 39 percent of the tonnages in the West North Central area and only 24 percent for the East North Central area.

Rock phosphate for direct application was the most important separate fertilizer material shipped during the 1948-49 year in the North Central area, with ordinary superphosphate and ammonium nitrate second and third in importance. Superphosphate (18-33%) was shipped in greatest volume in the West North Central States, with rock phosphate and triple superphosphate second and third in importance, respectively. Separate fertilizer materials shipped during the 12 months were as follows:

	<u>East North</u> <u>Central</u>	<u>West North</u> <u>Central</u>
	<u>Tons</u>	<u>Tons</u>
Ammonium nitrate-----	39,532	65,452
Rock phosphate-----	575,162	85,478
Superphosphate (18-33%)-----	148,998	212,860
Superphosphate (40-49%)-----	16,255	78,054
All other separate materials-----	78,894	26,918
 Total-----	858,841	468,762

The kinds of fertilizer tonnages shipped, by years, are included in appendix table 10. Other data on all separate fertilizer materials, on rock phosphate, and on liming materials are given in detail in appendix tables 12 through 17.

#### Seasonal Movement

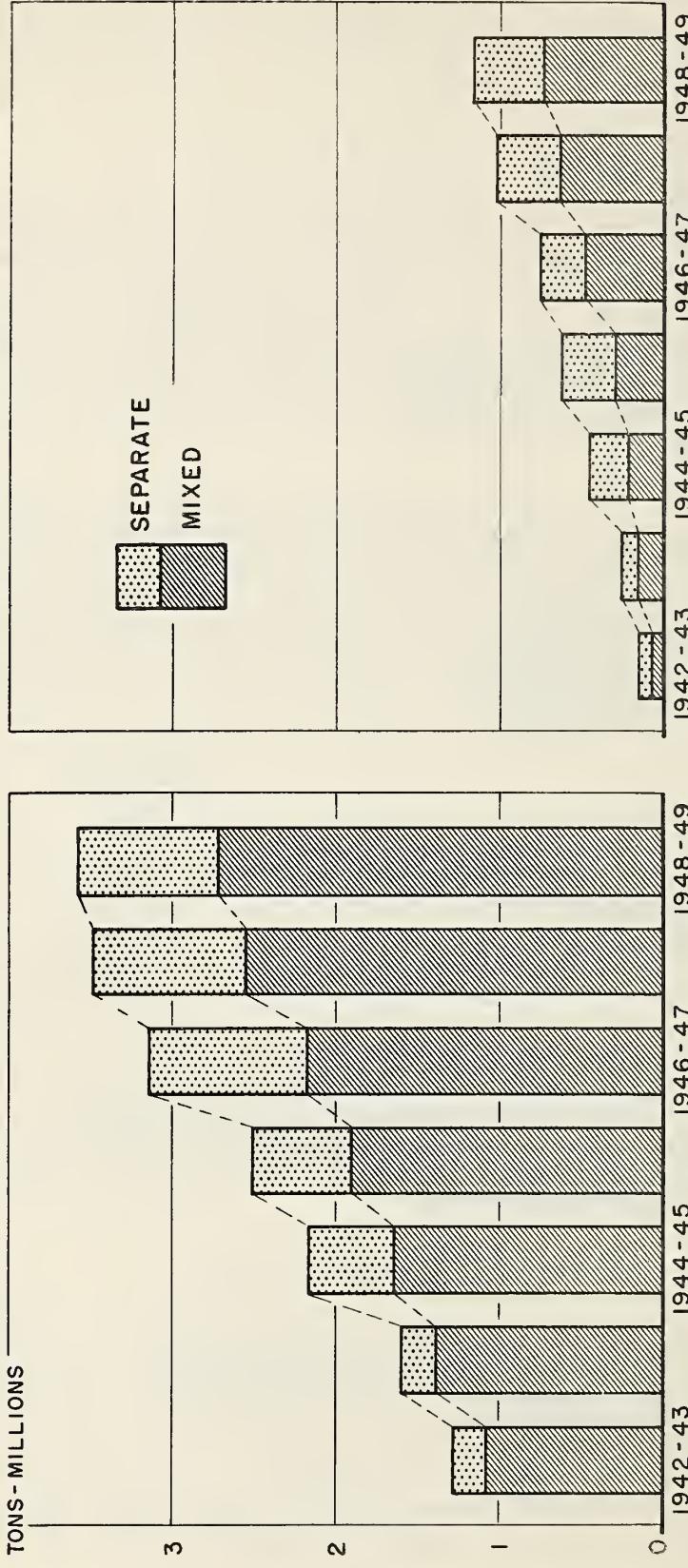
As in all parts of the country, shipments of fertilizer mixtures and separate materials in the North Central States are greater in the spring than for the fall (figure 13). For the 12 months' period ending June 30, 1949, two-fifths of all fertilizer shipments for the region were moved in the fall and three-fifths in the spring. Table C shows the percentage distribution of fall and spring shipments for mixed goods and for the more important separate fertilizer materials. Additional statistics on seasonal movement are presented in appendix tables 10 and 12 through 17.

FIGURE 12

SHIPMENT OF COMMERCIAL FERTILIZER MIXTURES AND SEPARATE MATERIALS BY KIND, NORTH CENTRAL STATES  
FALL 1942 THRU SPRING 1949▲

EAST NORTH CENTRAL STATES○

WEST NORTH CENTRAL STATES●

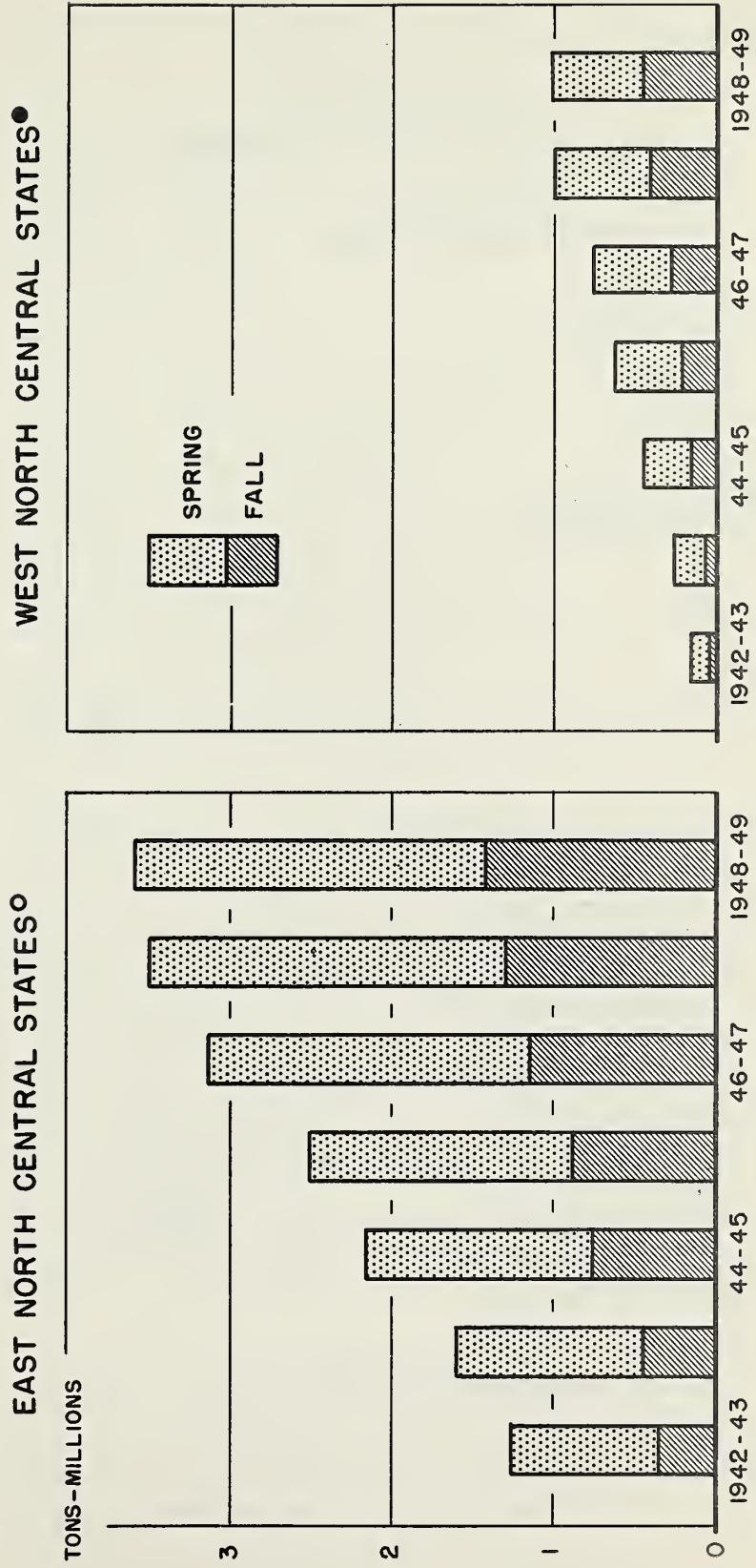


○ OHIO, INDIANA, ILLINOIS, MICHIGAN AND WISCONSIN.  
● MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA AND KANSAS.

▲ Includes ground rock phosphate, basic slag and minor element materials, such as borax, sulphur, manganese sulfate, etc.  
Also includes fertilizer distributed by Government agencies. Does not include liming materials, but includes gypsum.

FIGURE 13

SHIPMENT OF COMMERCIAL FERTILIZER MIXTURES AND SEPARATE MATERIALS, NORTH CENTRAL STATES, BY SEASONS  
FALL 1942 THRU SPRING 1949▲



○ OHIO, INDIANA, ILLINOIS, MICHIGAN AND WISCONSIN.

● MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA AND KANSAS.

▲ Includes ground rock phosphate, basic slag and minor element materials, such as borax, sulphur, manganese sulfate, etc. Also includes fertilizer distributed by Government agencies. Does not include liming materials, but includes gypsum.

Table C. - Seasonal shipment of fertilizer mixtures and separate materials, North Central States, by areas, for year ending June 30, 1949

Kind of fertilizer	Area			
	East North Central		West North Central	
	Fall 1948	Spring 1949	Fall 1948	Spring 1949
Mixed goods-----	Percent	Percent	Percent	Percent
Separate materials (all)-----	36	64	38	62
Separate materials less rock phosphate-----	53	47	43	57
Ammonium nitrate-----	35	65	42	58
Rock phosphate-----	(36)	(64)	(48)	(52)
Superphosphate (18-33%)-----	(61)	(39)	(35)	(65)
Superphosphate (40-49%)-----	(36)	(64)	(41)	(59)
All other separate materials-----	(39)	(61)	(53)	(47)
All fertilizer-----	(33)	(67)	(35)	(65)
	39	61	39	61

NOTE: See appendix tables 10 and 12 through 17 for detailed information.

#### SHIPMENTS BY REGIONAL COOPERATIVES<sup>5</sup>

Wholesale shipments of fertilizer mixtures and separate fertilizer materials by regional purchasing cooperatives in the North Central States have been absorbing an increasing share of all shipments during recent years (figure 14). These data include only the tonnages reported for regional associations. They do not reflect the wholesale shipments which local outlets received from sources of supply other than the regionals with which they are affiliated. Thus, the actual tonnages moving through cooperative retail channels can be assumed to be somewhat greater than the total wholesale shipments of regionals in the North Central States. By 1949, these cooperatives were wholesaling almost one-seventh of all fertilizer materials for the East North Central area and over one-fifth in the West North Central. Appendix table 18 shows cooperative shipments by kinds and seasons for the calendar years 1940-49.

The tremendous increase in wholesale fertilizer shipments by cooperatives during the past decade is shown in figure 15. The tonnages for 1949 were 505 percent greater than for 1940. From a percentage standpoint, the West North Central area reflected the most dynamic increase, or a 2,240 percent change during the 10-year period compared with 303 percent

<sup>5</sup>In this section rock phosphate is not included among separate materials. Tonnages handled cooperatively are shipped chiefly by one association and in one State.

FIGURE 14

WHOLESALE SHIPMENT OF FERTILIZER MIXTURES AND SEPARATE MATERIALS BY REGIONAL COOPERATIVES AS PERCENT OF ALL SHIPMENTS, BY SEASONS, NORTH CENTRAL STATES  
FALL 1942 THRU SPRING 1949▲

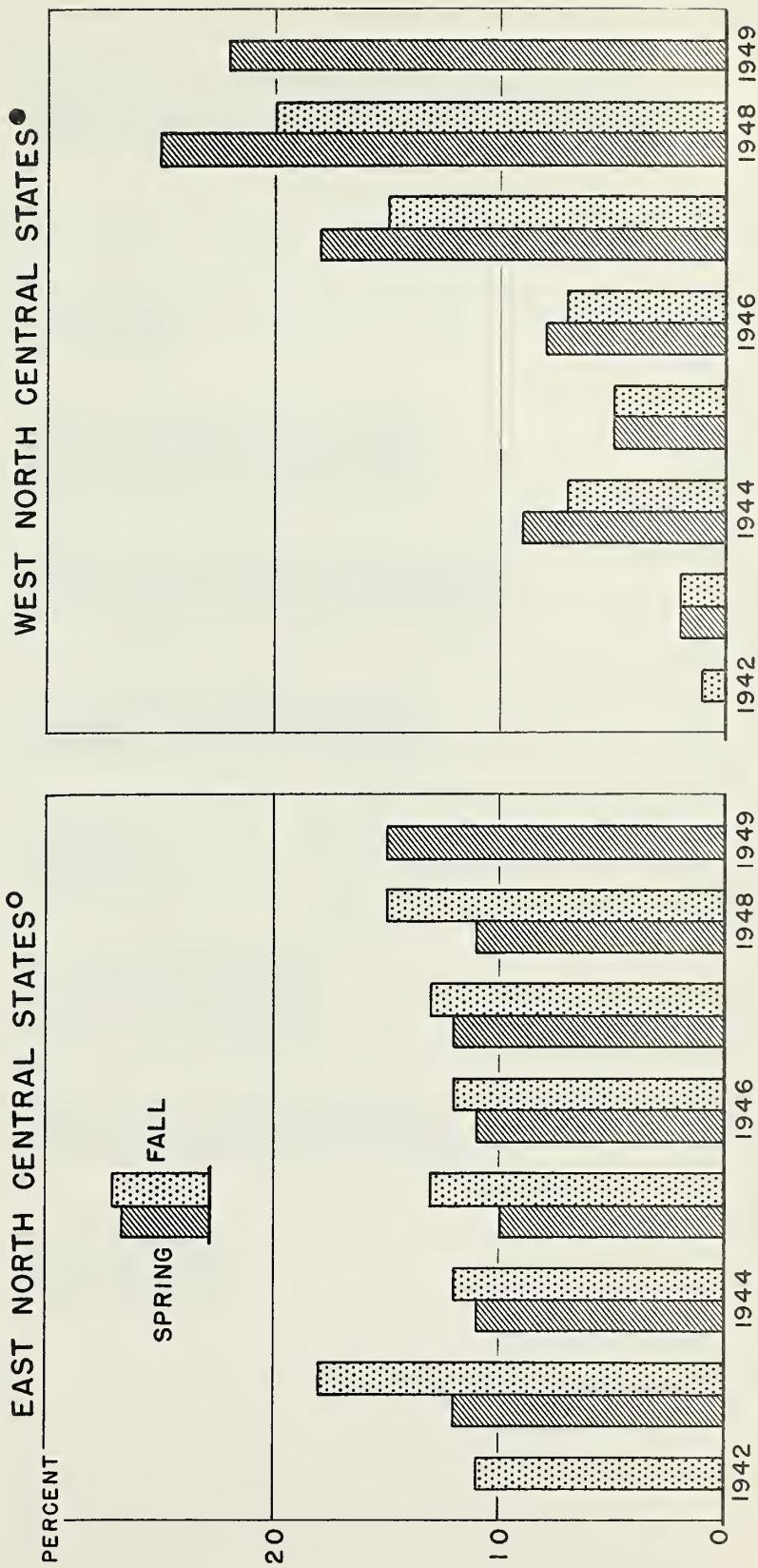
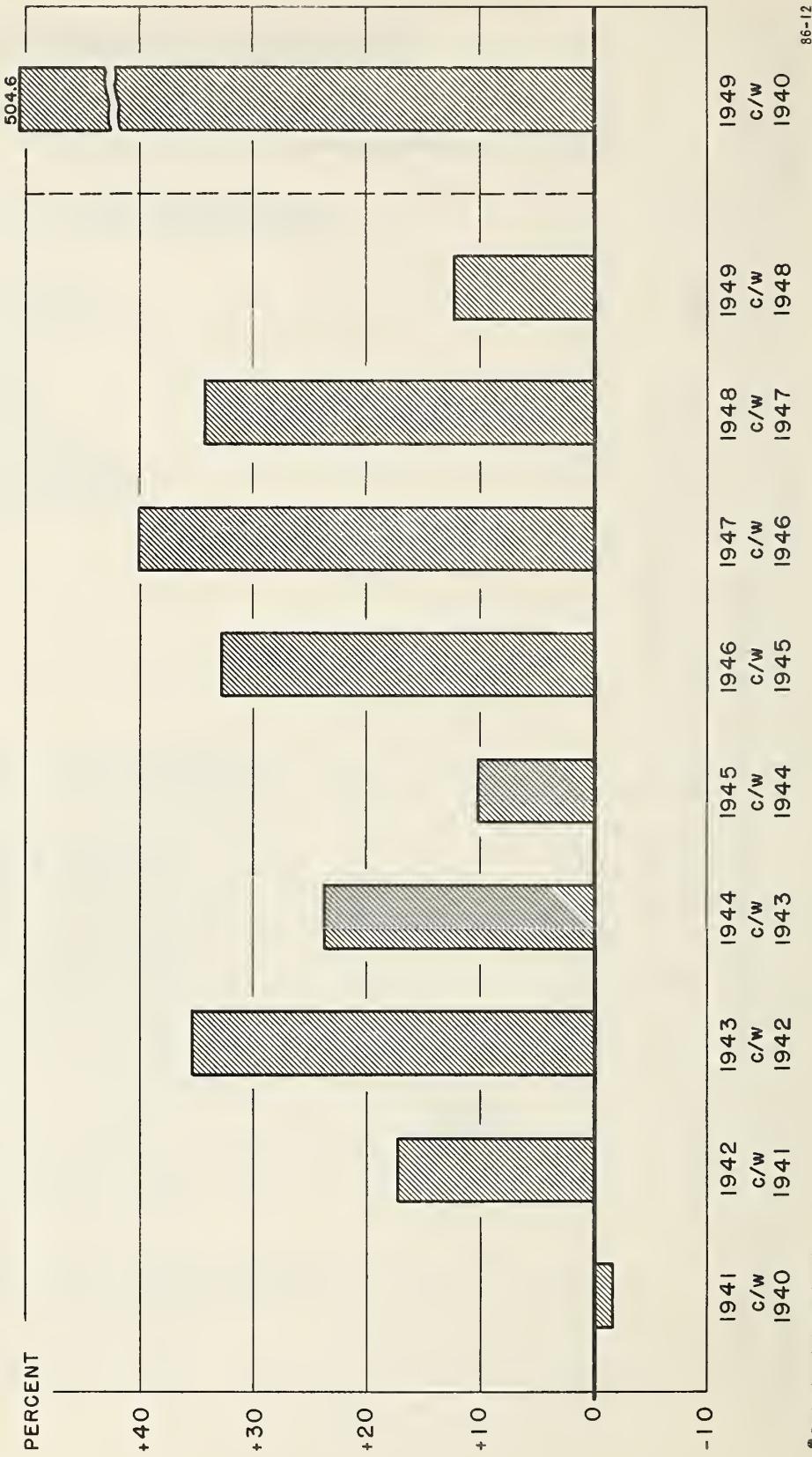


FIGURE 15

PERCENT CHANGE IN WHOLESALE SHIPMENT OF FERTILIZER MIXTURES  
AND SEPARATE MATERIALS BY REGIONAL COOPERATIVES  
NORTH CENTRAL STATES, CALENDAR YEARS 1940-49<sup>•</sup>



for the East North Central States. Appendix table 19 gives detailed area and regional changes in wholesale fertilizer shipments by cooperatives for the 10-year period 1940-49.

#### Kind of Fertilizer

Fertilizer mixtures have made up the greater portion of wholesale tonnages shipped cooperatively during the past decade (figure 16). During the calendar year 1949, three-fourths was mixed goods and one-fourth separate materials. The proportion of mixed goods was higher in the East North Central States, or 78 percent, compared with 70 percent for the West North Central area.

#### Seasonal Movement

Like other wholesale shippers in the region, cooperatives experience their peak movement of fertilizer materials during the spring. The seasonality of these shipments for the 10-year period 1940-49 is shown in figure 17.

For the year 1949 the spring movement accounted for 63 percent of the year's total of all materials shipped, and the fall share was 37 percent. The monthly movement of total mixed goods and separate materials for the year is presented graphically for each area in figure 18. These data must be interpreted only in light of what happened during 1949, a year in which shortages of some ingredients limited cooperatives in the extent to which they could provide separate materials in the quantities desired by members. For the same reason, cooperatives were unable to meet the demand for high analysis mixtures called for in their manufacturing plans for the year, and some members of affiliated outlets had to meet their needs through other suppliers.

The seasonality of shipments for separate fertilizer materials, by kind and exclusive of rock phosphate (see page 19), is presented in figure 19. Ordinary superphosphate ranked as the most important separate material shipped cooperatively in the East North Central area during 1949; triple superphosphate was more important in the West North Central. Appendix table 21 gives a detailed breakdown of separate materials by States, seasons, and areas.

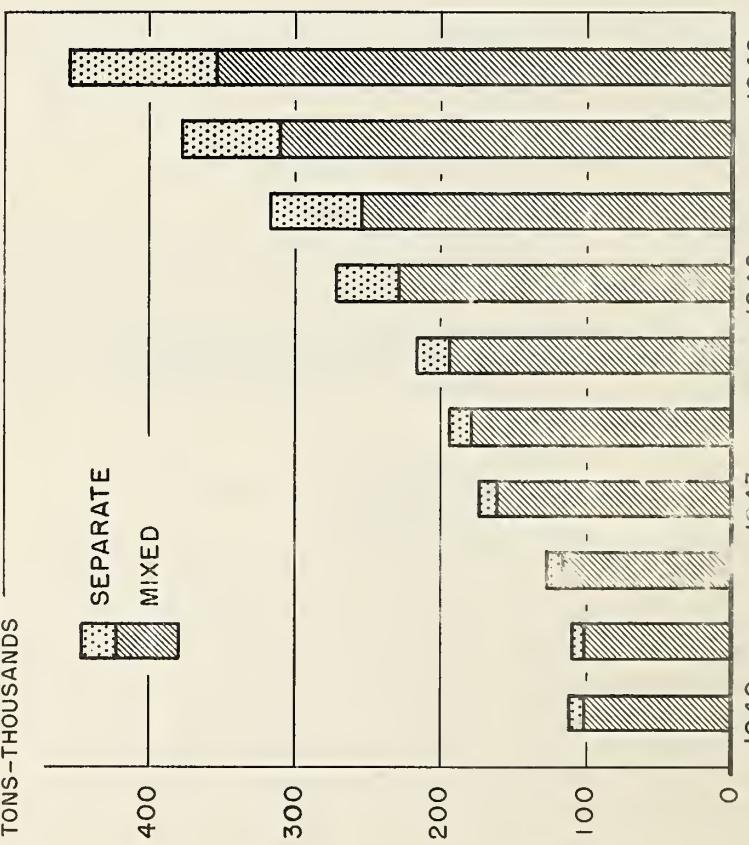
#### HIGH ANALYSIS PACE-SETTING

Regional purchasing cooperatives of the North Central States are setting the pace in distributing high analysis fertilizer mixtures. Their programs for manufacturing and distributing includes an increasingly larger number of plant food units per ton of mixed goods. This minimizes transportation costs and effects other economies in processing and handling, both for the cooperative manufacturer and the farmer. It is partly because of the regionals intensified efforts that new fertilizer laws have been enacted by legislatures of several States in the region for additional protection to the farmer who purchases fertilizer and for establishing minimum plant food requirements for mixtures. In the State

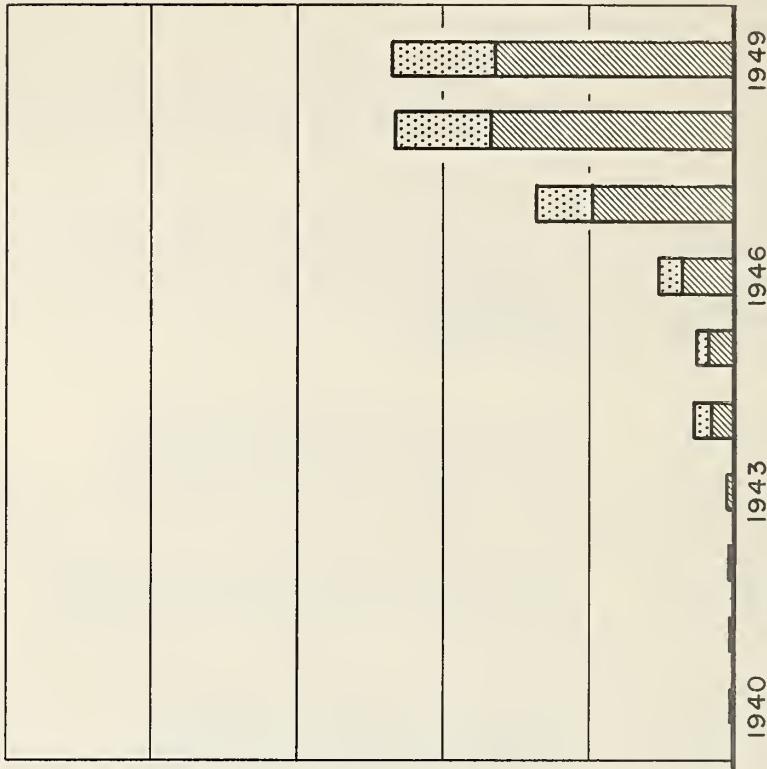
FIGURE 16

WHOLESALE SHIPMENT OF FERTILIZER MIXTURES AND SEPARATE MATERIALS BY REGIONAL COOPERATIVES, NORTH CENTRAL STATES, CALENDAR YEARS 1940-49▲

EAST NORTH CENTRAL STATES○



WEST NORTH CENTRAL STATES●

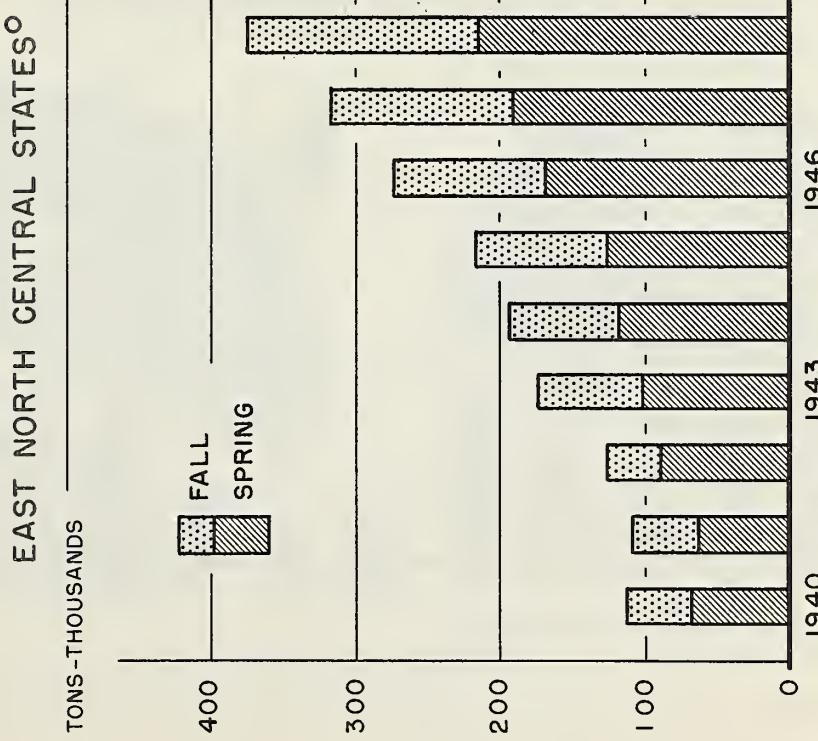


○ OHIO, INDIANA, ILLINOIS, MICHIGAN, AND WISCONSIN.  
 ● MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA, AND KANSAS.

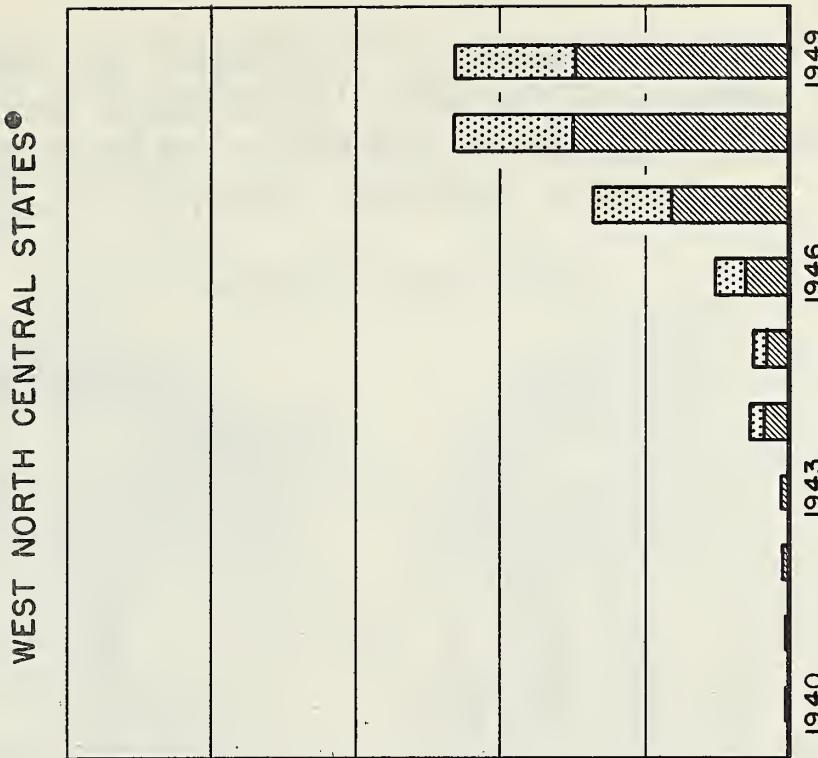
▲ Rock phosphate excluded.

FIGURE 17

WHOLESALE SHIPMENT OF FERTILIZER MIXTURES AND SEPARATE MATERIALS BY REGIONAL COOPERATIVES, NORTH CENTRAL STATES, BY SEASONS, CALENDAR YEARS 1940-49<sup>▲</sup>



WEST NORTH CENTRAL STATES<sup>○</sup>

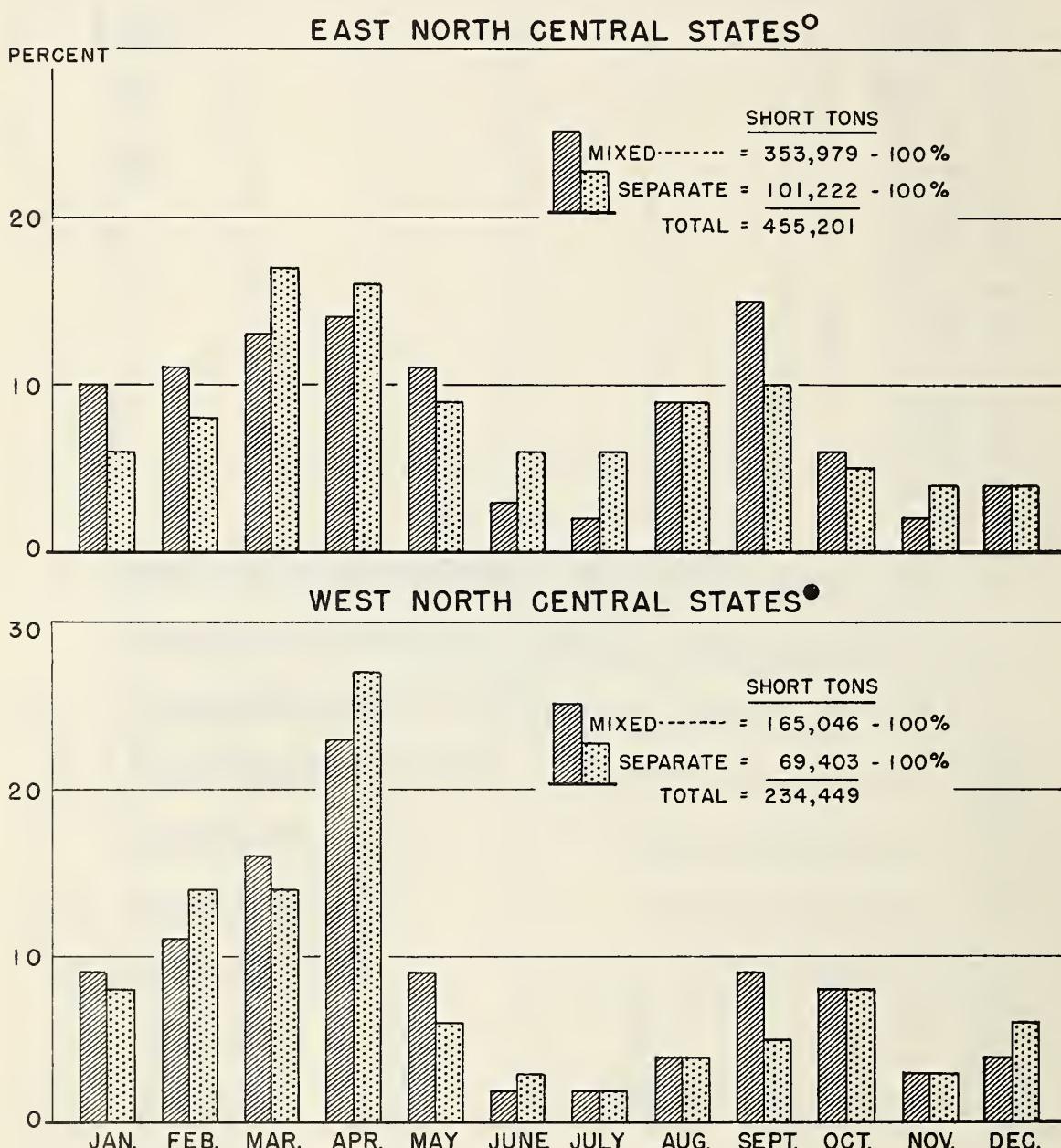


○ OHIO, INDIANA, ILLINOIS, MICHIGAN AND WISCONSIN.  
 ● MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA AND KANSAS.

▲ Rock phosphate excluded.

FIGURE 18

MONTHLY WHOLESALE SHIPMENT OF FERTILIZER  
MIXTURES & SEPARATE MATERIALS BY REGIONAL  
COOPERATIVES, AS PERCENT OF YEARLY SHIPMENTS  
NORTH CENTRAL STATES, 1949▲



° OHIO, INDIANA, ILLINOIS, MICHIGAN AND WISCONSIN.

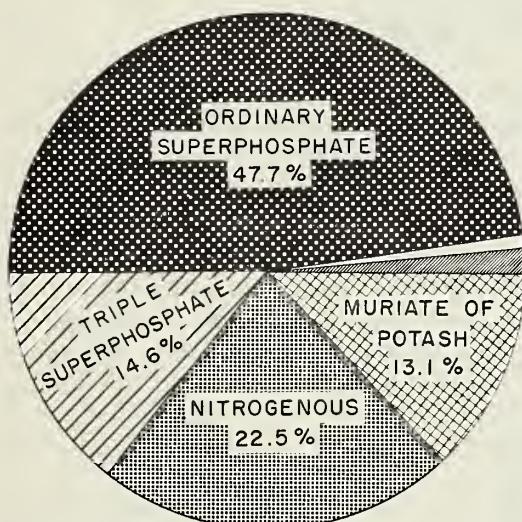
● MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA AND KANSAS.

▲ Rock phosphate excluded.

FIGURE 19  
 WHOLESAL SHIPMENT OF SEPARATE FERTILIZER  
 MATERIALS BY REGIONAL COOPERATIVES  
 NORTH CENTRAL STATES, BY SEASON, 1949▲

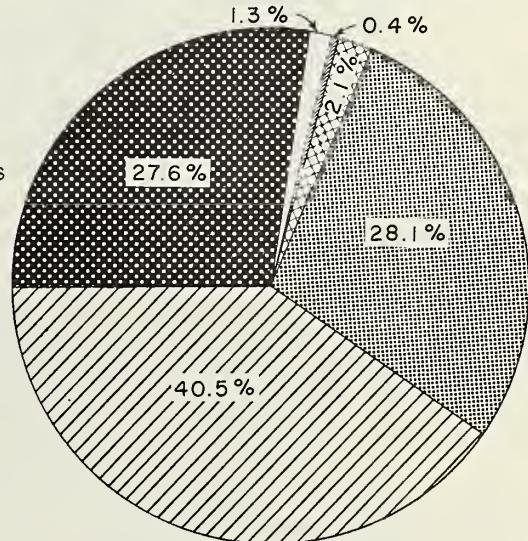
EAST NORTH CENTRAL○

SPRING = 61,588 TONS

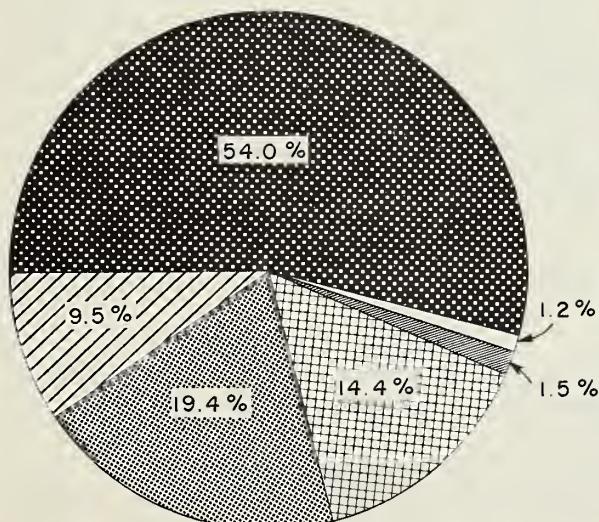


WEST NORTH CENTRAL●

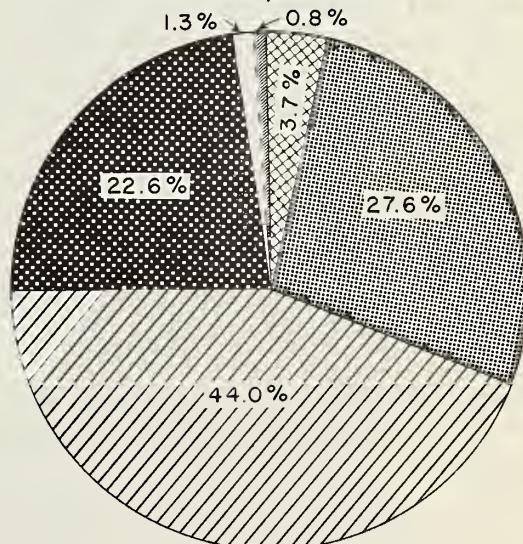
SPRING = 48,944 TONS



FALL = 39,634 TONS



FALL = 21,222 TONS



○ OHIO, INDIANA, ILLINOIS, MICHIGAN AND WISCONSIN.

● MINNESOTA, IOWA, MISSOURI, S. DAKOTA, N. DAKOTA, NEBRASKA AND KANSAS.

▲ Rock phosphate excluded.

of Minnesota, for example, the minimum plant food requirement of 27 units for a grade of fertilizer is the most rigid in the Nation.

The extent to which cooperatives are plant food pace-setters is reflected in the weighted average analysis of cooperative mixtures compared with all mixtures shipped in the region during the spring season of 1949 (figure 20). Appendix tables 22, 23, and 24 give additional data on average analysis of shipments.

## TRANSPORTATION AND ECONOMIC PROBLEMS

In the further development of their fertilizer manufacturing and distributing program, purchasing cooperatives of the North Central States are confronted with many problems. The more important relate to procuring raw materials, to methods of manufacturing mixtures and superphosphates, and to the ultimate movement of fertilizer materials to the farm. Transportation economics enters into any consideration of these problems as do other economic and technological factors which have a bearing on the price farmer co-op members must pay for plant food materials. The more important aspects of these problems which are characteristic of the cooperative fertilizer programs are discussed.

## COOPERATIVE POSITION IN THE INDUSTRY

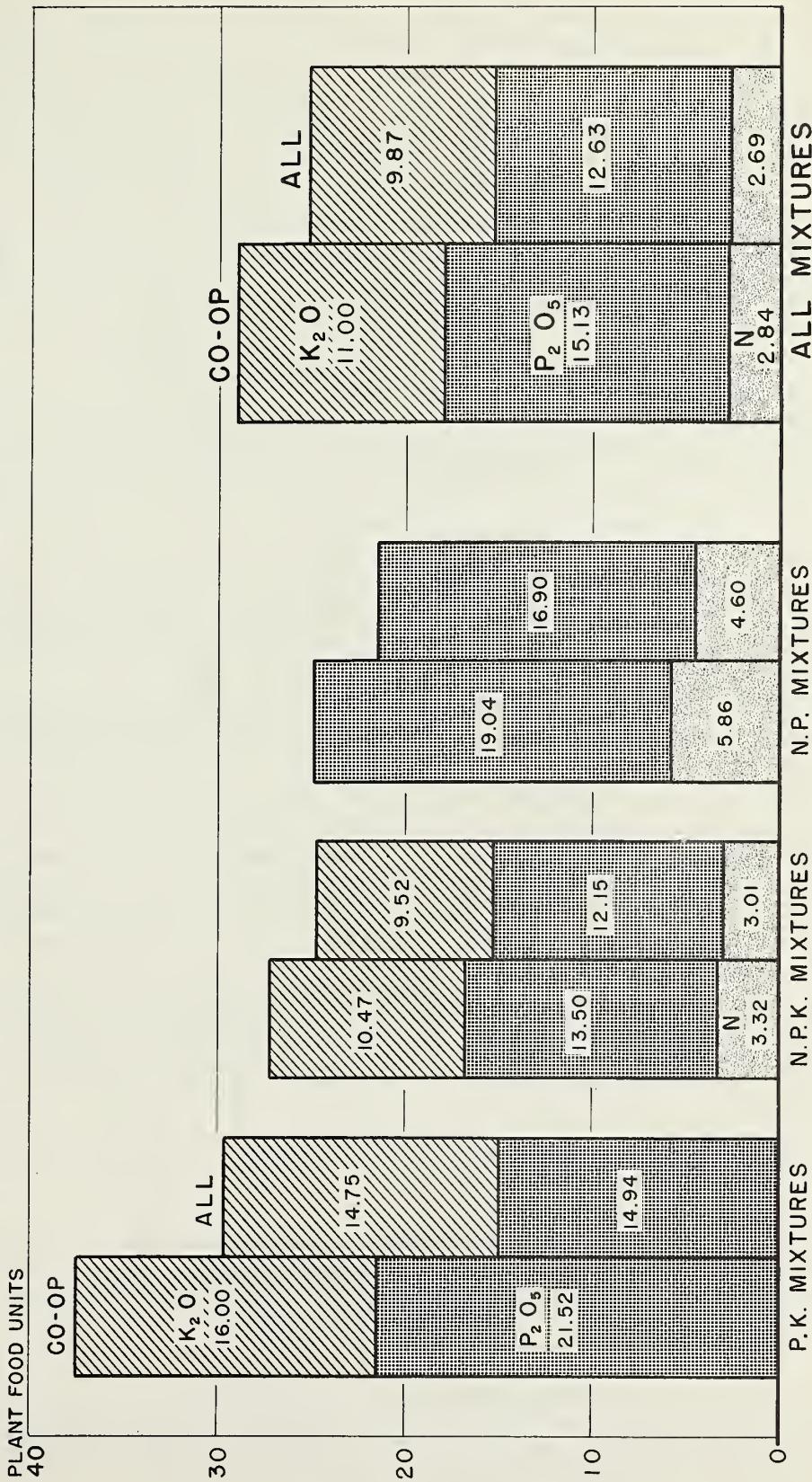
The combined cooperative output capacity for fertilizer mixtures and superphosphate in the North Central States is a relatively small segment of the Nation's fertilizer industry. Although some of the phosphatic and nitrogenous materials required in their manufacturing programs originate from TVA plants, the major sources of supply must come from the small number of large companies which dominate the domestic production of the principal raw materials. The largest producers of phosphate rock, superphosphate and potash not only depend upon the larger manufacturers as outlets for raw materials, but they themselves also rank among the largest mixers. This is particularly true of the phosphatic suppliers. Thus, cooperatives find themselves in the position of lesser producers dependent upon competitors whose operations are integrated from raw material to finished commercial fertilizer. Inherent in this dependence is the economic power of the completely integrated competitors to influence the supplies of raw material available to cooperative fertilizer manufacturers.

This fact was brought out in the "Report of the Federal Trade Commission on the Fertilizer Industry," submitted to Congress, January 9, 1950, as follows:

"...it appears that farmers' past inability to buy more of the grades they desire was due to lack of a free market for such materials, and that this, in turn, was due largely to price controls and other trade restraints concertedly applied by the small number of large producers who control the production of each of three principal fertilizer elements and the bulk of fertilizer mixing. Greater freedom on the part of farmers and small commercial mixers to buy whatever grades of fertilizer

FIGURE 20

WEIGHTED AVERAGE ANALYSIS FOR TYPES OF FERTILIZER MIXTURES  
SHIPPED IN NORTH CENTRAL STATES COMPARED WITH SHIPMENTS  
OF REGIONAL COOPERATIVES, SPRING SEASON, 1949\*



\* Data for cooperative shipments is based on 97 percent of mixtures reported. "All" shipments based on U.S.D.A. figures.

materials will serve their needs at least cost per unit of plant food requires more competition among materials producers than has existed in the past. Particularly with respect to high-grade superphosphates, it would appear that the development of additional producing capacity outside the direct control of large fertilizer mixers is badly needed. It still remains to be seen whether the warnings to the industry contained in the various consent decrees of the early 1940's have laid a basis for a larger degree of competition among producers to supply larger quantities of particular materials in a market more open to farmers and small independent mixers located in consuming areas far from points of production of primary fertilizer materials."

#### PROCUREMENT AND DISTRIBUTION BARRIERS<sup>6</sup>

Problems in procuring ingredients have hindered the cooperative fertilizer manufacturing and distributing program in the North Central States. As an example, during the year 1949, for which cooperatives provided data included in this study, there were months in which the supply of triple superphosphate was less than requirements. The demand for ammonium nitrate also exceeded supplies available to cooperatives, and the Central Farmers Fertilizer Company found it necessary to purchase anhydrous ammonia and have the material processed into ammonium nitrate.

During the same year arrangements entered into for purchasing potash from the Russian Occupied Zone of Germany were broken when the supplies were shipped to Japan at a price above that which the cooperatives had agreed to pay. Potash supplies for the fertilizer industry were placed on an allocation basis by the miners' strike in the Carlsbad, New Mexico, area during the latter part of the year. In meeting this shortage, some competitors of North Central cooperatives found it possible to procure foreign potash for their Eastern Seaboard plants and divert the major portion of their domestic allocations to mixing facilities in the North Central States. Although one Midwestern cooperative made arrangements with an Eastern association to exchange foreign purchased potash for the latter's domestic allocation in order to save on freight costs, the overall fertilizer program of North Central cooperatives was competitively at a disadvantage in procuring potash.

These farmer-owned plants are particularly vulnerable in procuring triple superphosphate, so important in the mixing of high-analysis grades of fertilizer. The supplies of this ingredient must be procured chiefly from companies whose mixing interests take precedence over acceptance of open market orders. As of mid-year 1950, there were 9 triple superphosphate plants in the United States with an annual capacity

<sup>6</sup>The supply factors as barriers in procurement and distribution are discussed in this section. It should be pointed out, however, that the price a farmer has to pay for fertilizer materials and his ability to pay that price also become a barrier or a limiting factor in fertilizer usage. The influence which cooperatives can exert in lowering fertilizer prices has been referred to on page 11. See appendix table 25 for combined index numbers of prices of fertilizer materials, farm products, and all commodities, 1940-49.

of 701,368 short tons (table 4). None of these plants is owned by cooperatives. Plans for meeting this need of cooperatives for a dependable supply of high phosphatic material are reaching fruition in a proposed program for developing their rock phosphate deposits in Idaho, referred to previously. In this connection, research is in progress by the Cooperative Research and Service Division to supplement this report with additional data pertinent to a consideration of factors in transportation economics basic to a cooperative fertilizer program. These additional data will be designed to: (1) Examine the role that farmer cooperatives should occupy in fertilizer manufacture and distribution under emergency conditions and the extent to which Western deposits of phosphate rock might be developed, and (2) analyze the economic and transportation implications of alternative methods of producing phosphatic fertilizers as they may be influenced by developments growing out of the defense effort. See appendix tables 26, 27, 28, and 29 for data related to ordinary superphosphate manufacturing capacity and facilities and appendix table 30 for mixing and acidulating capacity in the North Central States.

Since the outbreak of hostilities in Korea and the intensification of defense efforts, fertilizer ingredients rapidly became critical items. Supplies of phosphatic materials, which are needed in greatest quantities for mixing operations, were affected adversely by the shortage of sulfuric acid necessary in manufacturing ordinary superphosphate and also essential in the first step of the wet method of manufacturing triple superphosphate.<sup>7</sup>

Thus, cooperative acidulating plants have not been able to operate at full capacity in manufacturing ordinary superphosphate, and open market offerings of triple superphosphate have been considerably below cooperative requirements.

This situation, interpreted in terms of farmer-member needs, means a reduction in fertilizer supplies at a time when high production goals have been established for defense needs. These goals, in turn, mean removing more plant foods from the soil. Much of this must be returned in the form of commercial fertilizer if mining of soil resources is to be prevented. Appendix tables 31 through 35 give 1951 acreage guides established by U. S. Department of Agriculture, for defense needs.

<sup>7</sup>According to K. D. Jacob, Agricultural Research Administration, U. S. Department of Agriculture, approximately 95 percent of our present capacity for making chemically processed phosphate fertilizers is based on the use of sulfuric acid. Other processes which do not require sulfuric acid include the electric and blast-furnace processes for elemental phosphorus, nitric acid treatment of phosphate rock, thermal defluorination methods, calcination with alkali salts such as soda ash, and fusion of phosphate rock with magnesium silicate. Jacob states that the choice among them involves, along with other considerations, attention to such factors as (1) energy requirements, (2) cost and availability of raw materials, chemicals, and power, (3) plant and processing costs, (4) ease of operation of the process, (5) adaptability of the product to storage, distribution in the field, and inclusion in mixed fertilizers, (6) suitability of the product for use as fertilizer in the intended area of marketing, and (7) the applied-to-the-soil cost of the product to the farmer per unit of available  $P_2O_5$  in competition with  $P_2O_5$  from other sources.

Table D. - *Annual capacity of plants manufacturing triple superphosphate in the continental United States, calendar years 1930, 1940, 1945, 1947, and 1950<sup>1</sup>*

Year	Number of plants	Short tons	
		Material <sup>2</sup>	Available P <sub>2</sub> O <sub>5</sub> <sup>3</sup>
1930 <sup>4</sup>	5	97,800	44,000
1940 <sup>4</sup>	8	400,000	180,000
1945 <sup>5</sup>	9	496,500	223,400
1947 <sup>6</sup>	7	488,900	220,000
1950 <sup>6</sup>	9	701,368	315,616

<sup>1</sup>The data relate only to plants that operated or were definitely planned for operation in the years indicated. They represent the total maximum practical operating capacities of the individual plants on an annual basis at any time during the specific year regardless of the duration of operation.

<sup>2</sup>Basis 45 percent available P<sub>2</sub>O<sub>5</sub>.

<sup>3</sup>Total P<sub>2</sub>O<sub>5</sub> minus P<sub>2</sub>O<sub>5</sub> insoluble in neutral ammonium citrate solution.

<sup>4</sup>The capacity figures are from Parker et al (1946, p. 60).

<sup>5</sup>Data from Jacob (1948).

<sup>6</sup>As of July 15.

Compiled by K. D. Jacob, Agricultural Research Administration, U. S. Department of Agriculture.

In their procurement program regional purchasing cooperatives buy ingredients (1) to be used in mixing fertilizer grades and (2) to distribute to farmer members as a separate material for direct field application. Insufficient supplies have limited the extent to which separate materials have been made available to their members. As reported in the "Report of the Federal Trade Commission on the Fertilizer Industry, 1950," "Representatives of farmer organizations, in particular, continued through 1947 to complain of inability of their cooperatives to purchase separate fertilizer materials.<sup>8</sup> In 1949, with the supply situation generally easing, the complaints centered largely on superphosphate of high phosphoric acid content, respecting which testimony was given as follows:

"In phosphate, sale of high concentrates direct to farmers is discouraged if not forbidden by primary producers. In some areas, at least, there is a stiff differential price to mixers or dealers for high analysis phosphate which is to be sold direct to farmers as compared to that to be used in mixing."<sup>9</sup>

In times of material shortages, these associations must decide how to best allocate their available supplies in order to meet the needs of farmers they serve. If all materials received are processed into mixtures, in order to maximize the output of the fertilizer facility, farmers have no choice but must purchase mixtures of two or three components. They cannot procure separate materials for fields needing only one plant food. In long-range planning for manufacturing and distributing programs, in which cooperatives expect to integrate their

<sup>8</sup>Hearings, Senate Committee on Agriculture and Forestry on S. 1251, 1947, pp. 88-93 and 524-25.

<sup>9</sup>1949 Fertilizer Supplies: Hearings before a subcommittee of the Committee on Agriculture, House of Representatives, 81st Cong., 1st Sess., March 15-18, 1949, p. 54.

operations from mining to distributing, this problem has to be approached from the standpoints of greatest service to the farmer, the contribution to continuous soil building, and the resultant savings in cost of plant foods. In short-run planning with defense implications, the most important consideration is how to utilize available fertilizer materials efficiently in maximizing food and fiber production goals.

#### PROGRESS IN TECHNOLOGY

The development of improved methods of producing superior high analysis plant food materials is a constant challenge to fertilizer manufacturers and requires the skills and knowledge of chemistry, chemical engineering, and mechanical engineering. Cooperative fertilizer manufacturers in the North Central region have kept abreast of these technological changes. This is evidenced by their present facilities that include the latest type of "push-button" rock phosphate acidulating plants and a granulation plant for manufacturing granular material. Beyond this, distribution programs have been developed to include bulk spreading of fertilizer materials on farm fields and the direct application of anhydrous ammonia.

Entering into these technological changes are transportation and economic implications that demand consideration in long-range and defense program planning for procurement, storage, and methods of shipment for incoming and outgoing movements of fertilizer materials. Important among these considerations, which affect economy and efficiency in manufacture, the use, and the available transportation for moving fertilizer are as follows:

*Trend toward high analysis products.* - High analysis products have been developed because of high transportation costs and because of the need to reduce the amount of farmer's fertilizer cost which is represented by filler. In present defense effort, high analysis fertilizer when contrasted with lower analysis materials means savings in freight, in bags, and in labor both for the processor and for the farmer.

The real significance of these factors to the present defense effort can be interpreted in the light of the fact that we are now using almost three-fifths more fertilizer materials than in 1942 when A. L. Mehring of the Agricultural Research Administration, U. S. Department of Agriculture, wrote that, "The average mixed fertilizer moves about 100 miles. It requires the equivalent of 20,000 box cars moving 100 miles to have the half million tons of unnecessary filler in mixed fertilizers. It requires roughly 500 cars to move the filler in 50 percent muriate from the refineries to fertilizer factories about 2,000 miles away. This is equivalent to 10,000 cars moving 100 miles. It also requires the equivalent of another 1,000 cars moving 100 miles to have the filler in 16 percent superphosphate that could be eliminated if all of this grade was replaced with 18 percent superphosphate. So, adding these three items together we have a possible saving in transportation equivalent to a 100-mile movement of 31,000 cars."<sup>10</sup> It also means a

<sup>10</sup>Mehring A. L., "Higher Analysis Fertilizers as Related to the Victory Program," Better Crops With Plant Food Magazine, vol. 26, No. 1, 1942. p. 41.

money saving to the farmer in terms of plant food unit cost, as shown by the following average consumer cash price for three different fertilizer grades reported for 9 North Central fertilizer plants during April 1951:

Grade	Units of plant food	Price, per ton	Price, per unit of plant food
2-12-6	20	\$44.00	\$2.20
3-18-9	30	\$58.33	\$1.91
4-24-12	40	\$73.11	\$1.83

Change in price per unit of plant food from one grade to another will vary relatively with the cost of the additional amounts of N, P, and K which make up the higher grade. In this connection, it is stated in the "Report of the Federal Trade Commission on the Fertilizer Industry, 1950," that:

"In general it would appear that when fertilizer of varying grades is purchased from the same source and point of origin: (1) The cost of filler and the cost of transporting filler will be less per unit of plant food for a higher grade than for a lower grade of fertilizer. This is so because high-grade fertilizer contains less filler per ton than low-grade fertilizer. (2) The cost of bags and tax tags will be lower per unit of plant food for a higher grade fertilizer than for a lower grade. This is so because these costs accrue on a weight and not on a plant food unit basis, so that the cost of bag and tax per unit of plant food is less for a high grade than for a low grade mixture. (3) Administrative expenses, selling expenses, distributors' margins and mixers' profits may be either higher or lower per unit of plant food for a high-grade than for a low-grade fertilizer. Since, however, these costs amount to only about one-third of the total price of fertilizer to the farmer, they are of secondary importance as factors in the price per plant food unit paid by farmers. (4) The cost of active materials per unit of plant food will depend on the cost of each material taken separately, and on the amount of each of these in the formula in question. In general, however, it would appear that if the percentage of any one plant food is increased in a mixture, while the percentages of the other two are held constant, three different cost situations may occur: (a) If the unit cost of the varying element is constant or is reduced, the plant food unit cost of the mixture will be reduced, since the cost of filler per unit of plant food is also lowered. (b) If the unit cost of the varying element is increased by less than the reduction in cost of filler per unit of plant food, the plant food unit cost of the mixture will also be reduced, although by less than in the first case. (c) Only if the unit cost of the varying element is increased by more than the reduction in cost of filler per unit of plant food, will the plant food unit cost of the mixture be increased."

*The physical and chemical properties of materials used in modern fertilizer manufacture complicate problems of processing, shipping, and storage. - Materials include those which are highly hygroscopic, others which are nonhygroscopic, some that are very soluble, and others that*

are only slightly soluble, and still others that are in liquid form. Successful fertilizer processing requires techniques which surmount the difficulties inherent in these different chemicals so as to produce economically a finished product that: (1) Will not cake, harden, and react chemically, (2) will not separate or unmix when shipped because of difference in specific gravity and size and shape of particles, and (3) will possess drillability for uniform field distribution.

*Expanding cooperative programs of fertilizer manufacturing and distributing must be flexible.* - This permits incorporation of the latest technological developments in meeting requirements to best serve their farmer-members. The availability of financial resources determines the extent to which this flexibility is possible for cooperatives in the highly competitive fertilizer industry. For example, one cooperative in the North Central region reports that approximately \$500,000 was required to build and equip a plant completed in 1949. This facility has an annual rated output of approximately 20,000 tons of superphosphate and 35,000 tons of mixed goods. As groups of cooperatives integrate their fertilizer programs to include mining-to-distributing activities, their financial needs will grow in proportion to the scale of operations they undertake.

In program expansion cooperative management needs to consider such cost-influencing factors as: (1) The most advantageous location of producing plants from the standpoint of transportation costs for incoming and outgoing materials and from the standpoint of consuming areas,<sup>11</sup> (2) the most economical and practical method of storage for fertilizer materials after manufacturing and before purchase by the farm user;<sup>12</sup> (3) the form in which materials will be made available to farmers, i.e., separate materials of single components, granulated or ungranulated mixtures or both and, in the case of nitrogen, solid or liquid form or both; (4) the choice of the method for moving fertilizer materials to the farm, whether in bags or in bulk for direct field application, so as to minimize plant food cost, reduce handling, and conserve packaging supplies; (5) the selling of fertilizer mixtures on a basis of plant food units rather than a tonnage basis, whereby filler would be eliminated and ingredients other than N, P, and K would include only the amount necessary for conditioning the fertilizer to prevent caking, to supply secondary nutrients when needed, and to neutralize the acidity of the

<sup>11</sup>An important consideration in plant location is the extent to which fertilizer materials may be received by water transportation. Three North Central cooperative fertilizer facilities are located on the Mississippi River and have been receiving water shipments of fertilizer materials during the past two years. During 1950, for the first time, materials were loaded directly at Tampa, Fla. for one association and shipped across the Gulf and up the Mississippi without re-handling. Detailed information on water movement of fertilizer materials will be included in a report now in preparation on "Transportation cost factors basic to a cooperative fertilizer program in the North Central Region." (See appendix table 36 for origins of fertilizer ingredients as reported by one cooperative for 1949.)

<sup>12</sup>In this connection and of importance in the demands placed on freight equipment by defense needs, consideration must be given to the most efficient use of box cars and tank cars which are depended upon to supplement the storage function at many fertilizer plants until materials are consumed in processing.

mixture. This practice suggests the need for intensive education on the part of cooperatives and extension agronomists to counter any resistance on the part of farmers who might hesitate to pay the same price for fertilizer materials of less weight by pointing out the resultant economies in transportation, processing, and handling that accrue from eliminating filler.

## FINDINGS AND OBSERVATIONS

Regional purchasing cooperatives have greatly expanded their fertilizer programs in the North Central region during recent years. This is indicated by the following trends:

1. By April 1951 there were 29 cooperative mixing plants and 9 superphosphate acidulating plants in the region (figure 1 and table page 6).
2. The fertilizer programs of these associations included individual and joint activities for (1) procuring raw materials, (2) interchange of deliveries, (3) manufacturing fertilizer mixtures and superphosphate, (4) plant food research, and (5) a contemplated program for developing phosphate deposits in Idaho, and shipment from all sources to farmers.
3. New mixing and acidulating capacity in 1949 resulted in a 31 percent increase for mixtures and 38 percent for superphosphate over the 1948 output (figure 3).
4. For the year 1949, it is estimated that almost 500,000 tons of fertilizer materials were required for cooperative mixing plants in the region (figure 5 and page 16).
5. Sulphuric acid and ground rock phosphate required for manufacturing amounted to approximately 250,000 tons (figure 8 and page 19).
6. Total fertilizer shipments to farmers in the North Central States: (1) Included over one-fourth of total shipments in the United States during 1949 (figure 10); (2) showed a greater percentage change in shipments during the past 10 years than in the Nation (figure 11); and (3) included 77 percent mixtures and 23 percent separate materials for the year ending June 30, 1949, (figure 12), three-fifths of which moved in the spring and two-fifths in the fall (figure 13).
7. By 1949 cooperatives were wholesaling one-seventh of all fertilizer materials for the East North Central area and over one-fifth for the West North Central (figure 14). Three-fourths of these shipments were mixed goods and one-fourth was separate fertilizer materials (figure 16).
8. Regional purchasing cooperatives are leading the industry in distributing high analysis fertilizer mixtures (figure 20). This policy minimizes transportation costs per plant food unit and effects other economies in processing and handling, both for the cooperative manufacturer and the farmer.

A number of transportation and economic problems influence the decisions which regional purchasing cooperatives have made and will make in future planning for their expanding fertilizer program. The more important of these follow:

1. The extent to which cooperatives can integrate their operations in order to enhance their position as lesser producers. At present cooperatives are partially dependent upon highly integrated suppliers who also are competitors. In this connection, a most important consideration is a dependable supply of high phosphatic materials that may call for mining-to-distributing operations.
2. The development of long-range plans for manufacturing and distributing that will provide for (1) greater service to the farmer, (2) continuous soil building, and (3) savings in cost of plant foods.
3. Making adjustments in short-run plans, with defense implications, that will give emphasis to (1) efficient use of available fertilizer materials and (2) maximum production of food and fiber.
4. The ability to adapt to technological changes which affect procurement, processing, place of storage, and methods of shipping incoming and outgoing fertilizer materials. These include: (1) The trend toward high analysis products because of high freight costs and the need to reduce the amount of the farmer's fertilizer cost which is represented by filler; (2) the physical and chemical properties of materials used in modern fertilizer manufacture which complicate techniques required in producing economically a finished product that (a) will not cake or harden, (b) will not separate or unmix, and (c) will possess drillability; and (3) the need for flexibility that will permit the incorporation of the latest technological developments in processing and distributing.

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APPENDIX X

Table 1. - List of cooperative fertilizer mixing plants and acidulating plants which provided procurement and manufacturing data for study

Name and type of cooperative	Headquarters	Location of plant	Type of plant (s)			Type of ownership in 1949		
			Mixing	Acidulating	Mixing	Sole	Mixing	Joint <sup>1</sup>
<b>Regionals</b>								
1. The Farm Bureau Cooperative Assn., Inc.-----	Columbus, Ohio	Alliance, Ohio Dayton, Ohio Marietta, Ohio Maumee, Ohio Schererville, Ind. Fostoria, Ohio Glendale, Ohio Indianapolis, Ind. E. St. Louis, Ill. Saginaw, Mich. Prairie du Chien, Green Bay, Wis. Minneapolis, Minn. St. Paul, Minn. St. Paul, Minn. Green Bay, Wis. Winona, Minn. Springfield, Mo. Maryland Heights, Mo. St. Joseph, Mo. Eagle Grove, Iowa	X	X	X	X	X	X
2. Cooperative Plant Foods, Inc.-----	Columbus, Ohio	X	X	X	X	X	X	X
3. Ohio Farmers Grain and Supply Co.-----	Fostoria, Ohio	X	X	X	X	X	X	X
4. Farm Bureau Chemicals Co.-----	Columbus, Ohio	X	X	X	X	X	X	X
5. Indiana Farm Bureau Cooperative Assn., Inc.-----	Indianapolis, Ind.	X	X	X	X	X	X	X
6. Illinois Farm Supply Co.-----	Chicago, Ill.	X	X	X	X	X	X	X
7. Farm Bureau Services, Inc.-----	Lansing, Mich.	X	X	X	X	X	X	X
8. Wisconsin Cooperative Farm Plant Foods, Inc.-----	Madison, Wis.	X	X	X	X	X	X	X
9. Land O'Lakes Creameries, Inc.	Minneapolis, Minn.	X	X	X	X	X	X	X
10. Minnesota Farm Bureau Service Co.-----	St. Paul, Minn.	X	X	X	X	X	X	X
11. Northwest Co-op Mills, Inc.-----	St. Paul, Minn.	X	X	X	X	X	X	X
12. Missouri Farmers Association, Inc.-----	Columbia, Mo.	X	X	X	X	X	X	X
13. Consumers Cooperative Association-----	Kansas City, Mo.	X	X	X	X	X	X	X
<b>Locals</b>								
1. Coloma Fruit Exchange-----	Coloma, Mich.	X	X	X	X	X	X	X
2. Hamilton Farm Bureau Cooperative-----	Hamilton, Mich.	X	X	X	X	X	X	X
3. Wyocena Farmers Cooperative-----	Wyocena, Wis.	X	X	X	X	X	X	X
Total -----		23	9	19	8	4	4	1

<sup>1</sup> Owned by two or more purchasing cooperatives; act as manufacturing agents only.

<sup>2</sup> Not included is a granulation plant which began operations during December 1949.

NOTE: See table 2 for separate list of cooperatives which provided fertilizer distribution data.

Table 2. - *List of purchasing cooperatives which provided fertilizer distribution data for study*

	Name and type of cooperative	Headquarters
<b>Regionals</b>		
1.	The Farm Bureau Cooperative Association, Inc.	Columbus, Ohio
2.	Ohio Farmers Grain and Supply Company	Fostoria, Ohio
3.	Indiana Farm Bureau Cooperative Association, Inc.	Indianapolis, Ind.
4.	Illinois Farm Supply Company	Chicago, Ill.
5.	Farm Bureau Services, Inc.	Lansing, Mich.
6.	Wisconsin Cooperative Farm Plant Foods, Inc.	Madison, Wis.
7.	Central Cooperative Wholesale <sup>1</sup>	Superior, Wis.
8.	Minnesota Farm Bureau Service Company	St. Paul, Minn.
9.	Farmers Union Central Exchange, Inc. <sup>1</sup>	St. Paul, Minn.
10.	Land O'Lakes Creameries, Inc.	Minneapolis, Minn.
11.	Midland Cooperative Wholesale <sup>1</sup>	Minneapolis, Minn.
12.	Iowa Plant Food Co. <sup>2</sup>	Des Moines, Iowa
13.	Missouri Farmers Association, Inc.	Columbia, Mo.
14.	Consumers Cooperative Association	Kansas City, Mo.
15.	Missouri Farm Bureau Service Co. <sup>3</sup>	Jefferson City, Mo.
16.	Nebraska Non-Stock Cooperative <sup>3</sup>	Lincoln, Neb.
<b>Locals</b>		
1.	Coloma Fruit Exchange	Coloma, Mich.
2.	Hamilton Farm Bureau Cooperative	Hamilton, Mich.
3.	Fox River Valley Cooperative Wholesale <sup>3</sup>	Appleton, Wis.
4.	Wyocena Farmers Cooperative	Wyocena, Wis.

<sup>1</sup>Cooperatives which have joint ownership in manufacturing plants.

<sup>2</sup>A granulation plant owned by this association began manufacturing during December, 1949.

<sup>3</sup>Cooperatives which do no manufacturing, solely or jointly.

NOTE: See Table 1 for list of fertilizer mixing plants and acidulating plants which provided procurement and manufacturing data for study.

Table 3. - Seasonal receipts and use of materials by 16 fertilizer mixing and 9 acidulating plants of regional cooperatives, North Central States, 1949<sup>1</sup>

Item	Receipts					
	1949		Spring		Fall	
	Tons	Percent	Tons	Percent	Tons	Percent
1. Solid nitrogen compounds-----	19,947	100	10,324	52	9,523	48
2. Organic nitrogen-----	42	100	41	98	1	2
3. Ammoniating solutions-----	17,526	100	8,922	51	8,604	49
4. Phosphates-----	305,373	100	163,451	54	141,922	46
5. Potash-----	83,874	100	47,659	57	36,215	43
6. Conditioners, fillers, and minor elements-----	32,682	100	18,693	57	13,989	43
7. Acids-----	91,947	100	44,307	48	47,640	52
<b>Total-----</b>	<b>551,391</b>	<b>100</b>	<b>293,397</b>	<b>53</b>	<b>257,994</b>	<b>47</b>
<i>Used</i>						
1. Solid nitrogen compounds-----	17,642	100	7,876	45	9,766	55
2. Organic nitrogen-----	215	100	174	81	41	19
3. Ammoniating solutions-----	17,520	100	8,836	50	8,684	50
4. Phosphates-----	305,324	100	168,642	55	136,682	45
5. Potash-----	82,040	100	43,209	53	38,831	47
6. Conditioners, fillers, and minor elements	32,205	100	19,312	60	12,893	40
7. Acids-----	81,653	100	44,263	54	37,390	46
<b>Total-----</b>	<b>536,599</b>	<b>100</b>	<b>292,312</b>	<b>54</b>	<b>244,287</b>	<b>46</b>

<sup>1</sup>The 16 mixing plants manufactured approximately 73 percent of the fertilizer mixtures reported for 1949 by cooperatives, and the 8 acidulating plants accounted for 82 percent of the superphosphate manufactured. The 16 mixing operations included 4 new plants which operated for 10, 9, 7, and 6 months, respectively, during the year; 3 of the 8 acidulating facilities were new and operated for 10, 9, and 7 months, respectively.

Table 4. - *Monthly receipt of materials by fertilizer mixing and acidulating plants of regional cooperatives, East North Central States, 1949<sup>1</sup>*

Materials	Tons	Percent according to months										
		Total	January	February	March	April	May	June	July	August	September	October
Solid nitrogen compounds												
Ammonium nitrate	783	100	7	5	16	4	14	24	22	8	17	13
Cyanamid	229	100	7	5	13	7	100	13	17	13	19	19
Nitrate of soda	31	100	-	-	-	-	-	-	-	-	-	-
Sulphate of ammonia	13,982	100	5	7	8	9	8	10	15	5	7	7
Uranom	340	100	35	26	-	-	12	12	15	-	-	-
Total	15,365	100	6	7	8	8	9	11	15	5	7	10
Organic nitrogen	42	100	-	-	-	-	98	-	-	-	2	2
Ammoniating solutions	13,805	100	5	6	9	9	8	12	12	8	8	6
Phosphates												
Calcium metaphosphate	104	100	-	-	-	-	-	-	-	-	-	-
Rock phosphate	97,924	100	7	8	9	11	9	10	10	11	6	4
Superphosphate	1,41,666	100	6	8	12	10	8	8	11	8	7	5
Superphosphate	20%	100	-	-	5	15	9	15	15	12	8	10
Total	266,560	100	6	4	3	5	9	10	10	10	7	7
Potash												
Manure salts												
Muriate of potash	7,553	100	9	4	8	12	18	16	16	5	7	9
Muriate of potash	3,503	100	-	-	-	-	-	51	3	13	9	4
Muriate of potash	6,637	100	3	16	13	5	14	5	7	7	9	7
Muriate of potash	44,083	100	6	6	10	13	10	10	9	9	7	7
Sulphate of potash	63	100	-	-	19	-	-	-	-	-	78	78
Sulphate of potassium	442	100	-	22	23	-	-	-	-	45	-	-
Tobacco stems	4,705	100	-	2	21	13	2	1	1	-	-	-
Total	66,986	100	5	7	10	11	10	12	8	9	7	5
Conditioners, fillers, and minor elements												
Borax	57	100	-	4	-	10	2	2	2	3	-	7
Calcium carbonate	13	100	-	-	-	100	-	-	-	-	-	70
Copper sulphate	2	100	-	-	-	-	100	-	-	-	-	-
Dolomite	169	100	-	-	-	-	-	24	69	-	-	-
Dolomite	3,405	100	14	11	13	5	8	27	3	1	7	9
Fulmer's earth (spent)	2,946	100	-	-	-	13	23	30	9	14	8	3
Humus	129	100	-	-	23	-	-	-	23	51	-	3
Hydrated lime	3,527	100	11	5	13	-	1	16	2	15	4	10
Lime stone	134	100	8	-	29	5	5	90	-	19	3	5
Manganese sulphate	19	100	-	5	5	-	-	-	-	-	-	-
Mineral elements	1,878	100	8	4	12	14	12	5	5	5	8	13
Neutral phosphate	33	100	70	-	30	2	-	-	-	-	-	-
Pulverized lime	50	100	-	20	-	-	-	30	-	-	-	30
Rice hulls	143	100	34	2	-	36	-	-	-	-	-	28
Sand	10,117	100	(21)	1	11	20	13	8	10	1	5	13
Total	22,023	100	5	4	10	12	9	11	12	5	11	7
Acids												
Phosphoric acid	52	100	-	-	-	-	-	-	-	-	-	100
Sulphuric acid	81,915	100	6	6	10	10	7	8	8	9	13	6
Total	82,027	100	6	6	6	6	6	10	10	7	8	9

<sup>1</sup>See explanatory footnote on table 5.<sup>2</sup>Less than .006.

Table 5. - Monthly receipt of materials for fertilizer mixing and acidulating plants by regional cooperatives, West North Central States, 1949<sup>1</sup>

Materials	Tons	Percent according to months									
		Total	January	February	March	April	May	June	July	August	September
<u>Solid nitrogen compounds</u>											
Ammonium nitrate	325	100	42	12	12	-	-	25	9	-	-
Sulphate of ammonia	4,257	100	1	1	6	21	8	23	2	11	13
Total	4,582	100	4	2	6	20	7	22	8	3	10
<u>Ammoniating solutions</u>											
	3,721	100	10	8	11	11	13	5	9	6	8
<u>Phosphates</u>											
Rock phosphate	16,300	100	4	7	22	16	3	7	6	17	6
Superphosphate - 20%	9,236	100	17	15	12	29	12	1	4	2	6
Superphosphate - 45%	13,277	100	1	1	3	13	11	25	17	3	10
Total	38,813	100	6	7	13	18	8	12	9	4	11
<u>Potash</u>											
Manure salts	5,497	100	5	-	8	18	26	8	4	6	16
Muriate of potash - 50%	664	100	-	-	-	44	24	9	9	-	14
Muriate of potash - 60%	10,390	100	3	2	13	21	12	13	4	5	9
Sulphate of potash - magnesium	437	100	9	11	-	-	12	-	-	56	12
Total	16,988	100	3	2	11	20	17	11	4	5	10
<u>Conditioners, fillers, and minor elements</u>											
Borax	1	100	-	-	-	-	100	-	-	-	-
Calcium carbonate	1,123	100	15	3	47	-	-	1	1	14	17
Dolomite	4,196	100	1	9	7	36	7	1	5	7	9
Fuller's earth	435	100	27	9	8	-	10	19	18	-	-
Pulverized lime	37	100	-	-	81	19	-	-	-	-	-
Rice hulls	581	100	5	9	34	20	-	-	-	8	18
Sand	4,284	100	8	15	26	30	1	-	4	7	2
Soybean meal	2	100	-	-	-	-	-	100	-	-	-
Total	10,659	100	7	11	21	27	3	1	4	6	6
<u>Acids</u>											
Sulphuric acid	9,920	100	4	7	22	17	4	4	5	6	13
									9	6	3

<sup>1</sup>These data and those shown in appendix table 4 include materials received by 16 mixing plants which manufactured approximately 73 percent of the mixtures reported for 1949 by cooperatives, and also include the rock phosphate and acids received by 8 acidulating plants which accounted for 82 percent of the superphosphate acidulated. The 16 mixing operations included 4 new plants which operated for 10, 9, 7, and 6 months, respectively, during the year; 3 of the 8 acidulating facilities were new and operated for 1, G, 9, and 7 months, respectively.

Table 6. - Monthly use of materials by fertilizer mixing and acidulating plants of regional cooperatives, East North Central States, 1949<sup>1</sup>

Materials	Tons	Percent according to months										
		Total	January	February	March	April	May	June	July	August	September	October
Solid nitrogen compounds												
Ammonium nitrate	616	100	14	7	16	18	13	6	5	2	1	4
Cyanamide	421	100	7	14	14	4	4	3	3	8	4	17
Nitrate of soda	13,30	100	3	12	8	6	6	7	7	5	5	-
Sulphate of ammonia	13,176	100	5	20	21	2	3	28	-	5	10	22
Urea	13,172	100										-
Total	14,415	100	4	12	9	7	5	6	8	7	5	9
Organic nitrogen	215	100	42	18	10	6	5	-	16	2	-	-
Ammoniating solutions	13,963	100	4	8	9	9	7	11	11	8	8	7
Phosphates												
Calcium metaphosphate	98	100	-	-	-	-	-	-	-	-	-	-
Rock phosphate	95,697	100	6	8	12	8	9	9	10	9	10	-
Superphosphate	140,383	100	7	11	10	6	6	14	13	7	7	6
Superphosphate	27,297	100										-
Total	263,475	100	6	9	11	7	10	10	10	8	8	7
Potash												
Manure salts	8,384	100	8	10	15	18	5	6	9	9	12	2
Muriate of potash	6,329	100	5	13	16	6	7	8	10	8	7	7
Muriate of potash	49,739	100	6	10	9	9	1	1	10	8	7	5
Sulphate of potash	778	100	-	-	32	-	-	-	-	-	6	12
Sulphate of potash-magnesia	436	100	-	10	18	18	-	-	-	5	7	4
Tobacco stems	3,359	100	(2)	15	17	15	5	4	2	5	10	13
Total	68,325	100	6	10	11	10	6	9	9	8	8	7
Conditioners, fillers, & minor elements												
Borax	56	100	-	7	7	23	18	2	-	22	2	5
Calcium carbonate	88	100	-	60	24	6	-	-	-	-	-	-
Copper sulphate	2	100	-	-	-	-	100	-	-	-	-	-
Dicalite	10	100	-	-	-	90	10	-	-	-	-	-
Dolomite	130	100	-	-	-	-	-	30	18	30	17	5
Fullers earth	2,951	100	9	14	8	16	13	2	3	15	7	8
Humus	2,597	100	6	6	2	2	4	23	24	10	16	16
Hydrated lime	1,164	100	8	4	10	16	11	1	2	18	16	7
Limestone	3,322	100	9	7	13	11	1	1	7	7	7	13
Magnesium oxide	237	100	3	14	14	2	8	1	14	14	17	1
Manganese oxide	9	100	-	-	-	89	-	-	-	-	-	5
Mineral elements	2,273	100	8	13	14	4	2	7	4	9	7	11
Neutral phosphate	66	100	5	27	26	42	-	-	-	-	-	-
Pulverized lime	62	100	8	11	15	6	-	10	6	6	5	18
Rice hulls	277	100	13	35	20	7	1	14	3	3	14	5
Sand	10,094	100	2	3	8	20	15	14	3	4	12	7
Tea waste	41	100	100	-	-	-	-	-	-	-	-	-
Total	22,379	100	5	7	8	14	10	12	7	7	10	7
Acids												
Phosphoric acid	52	100	5	9	12	12	7	9	9	10	8	5
Sulphuric acid	71,669	100										-
Total	71,721	100	6	9	12	12	7	8	9	10	8	5

<sup>1</sup>See explanatory footnote on appendix table 7.

<sup>2</sup>Less than .006.

Table 7. - Monthly use of materials by fertilizer mixing and acidulating plants of regional cooperatives, West North Central States, 1949<sup>1</sup>

Materials	Tons	Percent according to months										
		Total	January	February	March	April 1	May	June	July	August	September	October
<u>Solid nitrogen compounds</u>												
Sulphate of ammonia	3,227	100	2	2	3	25	14	6	6	5	12	8
Ammoniating solutions	3,557	100	7	10	13	13	11	6	9	5	7	9
<u>Phosphates</u>												
Rock phosphate	15,643	100	4	7	20	14	6	5	6	6	12	9
Super phosphate - 20%	13,462	100	8	10	29	23	7	5	6	1	2	4
Super phosphate - 45%	12,744	100	4	4	6	20	7	11	12	7	8	7
Total	41,849	100	5	7	18	19	7	7	8	7	6	6
<u>Potash</u>												
Manure salts	4,567	100	6	7	6	22	10	6	5	8	13	12
Muriate of potash - 50%	566	100	-	-	30	36	-	10	9	-	8	6
Muriate of potash - 60%	8,168	100	7	6	11	19	9	5	5	9	7	8
Sulphate of potash - magnesia	379	100	-	24	-	-	-	14	16	11	-	8
Sulphate of potash	39	100	-	-	-	-	-	-	-	-	-	27
Total	13,719	100	6	6	9	20	10	5	5	6	10	9
<u>Conditioners, fillers and minor elements</u>												
Calcium carbonate	950	100	15	4	47	1	1	2	-	14	13	-
Dolomite	3,796	100	2	8	5	26	13	7	2	6	12	9
Fullers earth	399	100	4	13	8	25	7	-	9	8	7	3
Pulverized lime	66	100	11	8	30	-	6	3	4	8	-	9
Rice hulls	549	100	5	5	32	29	-	1	6	-	10	10
Sand	4,063	100	8	13	25	30	3	-	4	8	1	2
Soybean meal	3	100	-	-	-	-	67	33	-	-	-	-
Total	9,826	100	6	10	19	25	6	3	3	6	7	6
<u>Acids</u>												
Sulphuric acid	9,932	100	4	6	21	16	5	4	6	8	12	9

<sup>1</sup>These data and those shown in table 6 include materials used by 16 mixing plants which manufactured approximately 73 percent of the mixtures reported for 1949 by cooperatives, and also include the rock phosphate and acids used by 8 acidulating plants which accounted for 82 percent of the superphosphate actuated. The 16 mixing operations included 4 new plants which operated for 10, 9, 7, and 6 months, respectively, during the year; 3 of the 8 acidulating facilities were new and operated for 10, 9, and 7 months, respectively.

Table 8. - Percentage of material shipments received, fertilizer mixtures manufactured, and plant shipments reported for 16 mixing plants of regional cooperatives, North Central States, by months, calendar year 1949<sup>1</sup>

Month	Materials received	Mixtures manufactured	Plant shipments
	Percent	Percent	Percent
January-----	5	9	8
February-----	7	10	11
March-----	10	12	14
April-----	12	14	16
May-----	10	9	11
June-----	11	7	2
July-----	10	6	2
August-----	7	7	8
September-----	7	7	15
October-----	7	6	7
November-----	8	7	1
December-----	6	6	5
<b>Total-----</b>	<b>100</b>	<b>100</b>	<b>100</b>

<sup>1</sup>These 16 plants manufactured approximately 73 percent of the fertilizer mixtures reported for 1949 by cooperatives. Included in the 16 are 4 new plants which operated for 10, 9, 7, and 6 months, respectively during the year.

Table 9. - Monthly tonnages of fertilizer mixtures manufactured by 20 mixing plants and 9 acidulating plants of regional cooperatives, North Central States, calendar year 1949

Month	Mixtures manufactured <sup>1</sup>	Ordinary superphosphate manufactured
	Tons	Tons
January-----	42,204	14,076
February-----	48,849	17,658
March-----	64,243	29,743
April-----	70,281	29,056
May-----	43,871	15,272
June-----	30,016	16,382
July-----	29,969	18,938
August-----	35,102	20,825
September-----	35,916	19,339
October-----	38,587	13,803
November-----	35,028	11,354
December-----	32,548	16,173
<b>Total-----</b>	<b>506,614</b>	<b>222,619</b>

<sup>1</sup>Includes actual figures or estimates for plants which accounted for 98 percent of cooperatively mixed goods.

Table 10. - Shipment of commercial fertilizer mixtures and separate materials in North Central States and continental United States, fall 1942 through spring 1949<sup>1</sup>

Year	Season	Kind of fertilizer	East North Central		West North Central		Total		
			Tons	Percent of U.S.	Tons	Percent of U.S.	Regional		United States
							Tons	Percent of U.S.	Tons
1942-----	Fall	Mixed Separate	261,128 95,450	22.6 6.9	9,342 32,657	0.8 2.4	270,470 128,107	23.4 9.3	1,157,855 1,375,677
		Total	356,578	14.1	41,999	1.7	398,577	15.7	2,533,532
		Mixed Separate	819,827 106,431	12.7 4.1	84,717 34,432	1.3 1.3	904,544 140,863	14.0 5.4	6,475,293 2,611,122
1943-----	Spring	Total	926,258	10.2	119,149	1.3	1,045,407	11.5	9,086,415
		Mixed Separate	372,254 95,593	22.4 8.1	31,609 38,142	1.9 3.2	403,863 133,735	24.1 11.3	1,674,829 1,184,701
		Total	467,847	16.4	69,751	2.4	537,598	18.8	2,859,530
1944-----	Spring	Mixed Separate	1,018,721 130,898	15.1 5.3	121,236 71,515	1.8 2.9	1,139,957 202,413	16.9 8.2	6,746,078 2,465,198
		Total	1,149,619	12.5	192,751	2.1	1,342,370	14.6	9,211,276
		Mixed Separate	502,857 239,216	28.7 14.9	52,524 112,108	3.0 7.0	555,381 351,324	31.7 21.9	1,752,610 1,601,063
1945-----	Spring	Total	742,073	22.1	164,632	4.9	906,705	27.0	3,353,673
		Mixed Separate	1,151,787 282,428	16.2 10.3	173,657 123,976	2.4 4.5	1,325,444 406,404	18.6 14.9	7,117,934 2,729,722
		Total	1,434,215	14.6	297,633	3.0	1,731,848	17.6	9,847,656
1946-----	Fall	Mixed Separate	569,539 316,894	29.8 16.2	72,452 149,955	3.8 7.7	641,991 466,849	33.6 23.9	1,908,686 1,956,586
		Total	886,433	22.9	222,407	5.8	1,108,840	28.7	3,865,272
		Mixed Separate	1,335,060 294,463	16.6 10.6	231,382 181,841	2.9 6.5	1,566,442 476,304	19.4 17.1	8,054,356 2,784,326
1947-----	Spring	Total	1,629,523	15.0	413,223	3.8	2,042,746	18.8	10,838,682
		Mixed Separate	727,609 431,969	25.3 20.0	171,981 120,302	6.0 5.6	899,590 552,271	31.3 25.5	2,876,348 2,164,155
		Total	1,159,578	23.0	292,283	5.8	1,451,861	28.8	5,040,503
1948-----	Fall	Mixed Separate	1,470,089 529,687	17.1 18.5	317,604 160,370	3.7 5.6	1,787,693 690,057	20.8 24.1	8,600,894 2,865,280
		Total	1,999,776	17.4	477,974	4.2	2,477,750	21.6	11,466,174
		Mixed Separate	848,604 459,491	27.9 18.0	243,545 169,656	8.0 6.7	1,092,149 629,147	35.9 24.7	3,042,919 2,547,829
1949-----	Spring	Total	1,308,095	23.4	413,201	7.4	1,721,296	30.8	5,590,748
		Mixed Separate	1,719,485 472,739	19.3 15.6	404,822 209,908	4.6 6.9	2,124,307 682,647	23.9 22.6	8,892,307 3,024,697
		Total	2,192,224	18.4	614,730	5.2	2,806,954	23.6	11,917,004
1949-----	Fall	Mixed Separate	972,066 443,347	31.5 19.6	279,005 201,424	9.0 11.2	1,251,071 644,771	40.6 35.1	3,084,982 2,263,079
		Total	1,415,413	26.5	480,429	9.0	1,895,842	35.4	5,348,061
		Mixed Separate	1,763,778 415,494	18.6 12.4	462,865 267,338	4.9 8.0	2,226,643 682,832	23.4 20.4	9,503,483 3,349,343
		Total	2,179,272	17.0	730,203	5.7	2,909,475	22.6	12,852,826

<sup>1</sup>Includes ground rock phosphate, basic slag and minor element materials, such as borax, sulphur, manganese sulphate, etc. Also includes fertilizer distributed by Government agencies. Does not include liming materials, but includes gypsum.

Table 11. - Percent change in shipment of fertilizer mixtures and separate materials, North Central States and continental United States, by years and seasons, fall 1942 through spring 1949<sup>1</sup>

Comparison	Yearly total		Fall		Seasonal totals		Spring	
	Area	Percent change	Comparison	Area	Percent change	Comparison	Area	Percent change
1943-44 c/w 1942-43	East North Central West North Central United States	26.1 64.8 3.9	1943 c/w 1942	E.N.C. W.N.C. U.S.	31.2 66.1 12.9	1944 c/w 1943	E.N.C. W.N.C. U.S.	E.N.C. W.N.C. U.S.
1944-45 c/w 1943-44	East North Central West North Central United States	34.5 74.1 9.4	1944 c/w 1943	E.N.C. W.N.C. U.S.	58.6 136.0 17.3	1945 c/w 1944	E.N.C. W.N.C. U.S.	E.N.C. W.N.C. 6.9
1945-46 c/w 1944-45	East North Central West North Central United States	15.6 37.5 11.4	1945 c/w 1944	E.N.C. W.N.C. U.S.	19.3 35.1 15.3	1946 c/w 1945	E.N.C. W.N.C. U.S.	E.N.C. W.N.C. 13.6
1946-47 c/w 1945-46	East North Central West North Central United States	25.6 21.2 12.3	1946 c/w 1945	E.N.C. W.N.C. U.S.	30.8 31.4 30.4	1947 c/w 1946	E.N.C. W.N.C. U.S.	E.N.C. W.N.C. 10.1
1947-48 c/w 1946-47	East North Central West North Central United States	10.8 33.5 6.1	1947 c/w 1946	E.N.C. W.N.C. U.S.	12.8 41.4 10.9	1948 c/w 1947	E.N.C. W.N.C. U.S.	E.N.C. W.N.C. 5.8
1948-49 c/w 1947-48	East North Central West North Central United States	2.7 15.8 4.0	1948 c/w 1947	E.N.C. W.N.C. U.S.	8.2 11.4 (-4.3)	1949 c/w 1948	E.N.C. W.N.C. U.S.	E.N.C. W.N.C. 7.9

<sup>1</sup>Includes ground rock phosphate, basic slag and minor element materials such as borax, sulphur, manganese sulphate, etc. Also includes fertilizer distributed by Government agencies. Does not include liming materials, but includes gypsum.

c/w = Compared with.

( ) = Decrease.

E.N.C. = Ohio, Indiana, Illinois, Michigan, and Wisconsin.

W.N.C. = Minnesota, Iowa, Missouri, South Dakota, North Dakota, Nebraska, and Kansas.

US = Continental United States.

Table 12. - *Shipment of separate fertilizer materials, East North Central States, fall season 1948*

Item	Ohio	Indiana	Illinois	Michigan	Wisconsin	Total
(Short tons)						
<u>Chemical nitrogen</u>						
Ammonium nitrate-----	983	1,877	5,425	909	4,842	14,036
Ammonium sulphate-----	741	102	186	129	47	1,205
Cal-Nitro-----	960	300	-	-	-	1,260
Cyanamid-----	1,601	260	575	180	-	2,616
Nitrate of soda-----	246	79	420	72	12	829
Uramon-----	116	-	-	-	-	116
Calcium nitrate-----	-	90	-	-	-	90
<u>Organics</u>						
Dried manure, cattle-----	-	-	231	-	10	241
Dried manure, sheep-----		99	361	-	103	563
Dried manure, unspecified-----	112	-	17	129	-	258
Sewage sludge, activated--	2,672	518	1,806	2,177	1,073	8,246
Sewage sludge, other-----	-	-	-	-	7	7
<u>Phosphates</u>						
Ammonium phosphate 11-48-	-	-	-	-	1,069	1,069
Ammonium phosphate 16-20-	-	50	420	-	270	740
Bone meal-----	195	-	-	-	-	195
Bone meal, steamed-----	-	3	121	126	34	284
Calcium meta phosphate---	375	-	120	-	-	495
Rock phosphate-----	1,240	29,414	312,337	717	4,969	348,677
Colloidal rock phosphate--	-	490	2,176	-	40	2,706
Superphosphate-----18%	2,128	250	3,534	2,958	337	9,207
Superphosphate-----19%	-	-	-	-	4	4
Superphosphate-----20%	6,279	6,131	14,187	4,975	4,597	36,169
Superphosphate-----33%	-	-	-	32	-	32
Superphosphate-----40%	1,306	-	-	-	-	1,306
Superphosphate-----43%	-	171	-	-	2	173
Superphosphate-----44%	-	63	19	-	-	82
Superphosphate-----45%	-	815	3,299	361	232	4,707
<u>Potash</u>						
Manure salts-----25%	-	55	309	-	61	425
Muriate of potash--50%	1	173	1,858	-	251	2,283
Muriate of potash--60%	104	138	4,288	20	586	5,136
Sulphate of potash, magnesia-----	-	40	81	-	-	121
<u>Secondary elements</u>						
Borax-----	-	-	-	-	61	61
Aluminum sulphate-----	-	-	1	-	1	2
Es-Min-El-----	-	-	-	1	-	1
Manganese sulphate-----	-	2	-	3	-	5
Total-----	19,059	41,120	351,771	12,789	18,605	443,347

Table 13. - Shipment of separate fertilizer materials, West North Central States, fall season 1948

Fertilizer materials	Minnesota	Iowa	Missouri	Nebraska	North Dakota	South Dakota	Kansas	Total
(Short tons)								
Chemical nitrogen								
Ammonium nitrate-----	1,751	8,681	5,022	4,431	240	120	2,537	22,782
Ammonium phosphate--11-48-	1,211	-	-	-	40	-	-	251
Ammonium phosphate--16-20-	1,195	2,040	-	80	120	-	-	3,715
Ammonium sulphate-----	157	124	175	20	-	-	-	475
Cyanamid-----	2	11	135	-	-	-	-	148
Nitrate of soda-----	-	-	80	-	-	-	-	80
Organics								
Dried manure - Sheep-----	86	30	148	43	-	-	-	79
Sewage sludge, activated-----	501	363	865	60	-	-	-	45
Sewage sludge, other-----	2	-	-	-	-	-	-	1
Bone meal, raw-----	-	-	48	-	-	-	-	2
Bone meal, steamed-----	21	3	-	-	-	-	-	52
Phosphates								
Rock phosphate-----	2,067	15,257	17,975	100	160	310	2,439	38,308
Colloidal rock phosphate-----	300	2,090	-	-	-	-	-	2,390
Calcium meta phosphate-----	-	-	-	-	-	-	-	30
Superphosphate--18%-----	571	1,228	-	-	40	30	9,861	33,210
Superphosphate--20%-----	15,706	14,200	12,210	21,480	1,130	814	8,909	54,219
Superphosphate--42%-----	-	-	-	783	-	40	-	823
Superphosphate--43%-----	589	-	-	-	33	-	-	4,812
Superphosphate--44%-----	-	-	-	-	-	-	-	580
Superphosphate--45%-----	5,432	4,805	7,515	195	-	105	500	18,552
Superphosphate--46%-----	3,365	49	-	193	963	43	3,922	8,535
Superphosphate--47%-----	5,529	43	-	-	1,200	-	78	6,850
Superphosphate--48%-----	305	-	-	-	-	-	575	6,880
Potash								
Manure salts--25%-----	12	603	207	-	-	-	-	822
Muriate of potash--50%-----	-	192	-	-	-	-	-	192
Muriate of potash--60%-----	6	205	826	-	-	-	1	1,038
Secondary elements								
L. P. Gypsum-----	3,09	50	30	40	-	-	-	429
Manganese sulphate-----	1	-	-	-	-	-	-	1
Aluminum sulphate-----	-	-	-	-	-	-	-	3
Total-----	38,018	49,974	45,236	28,675	3,926	1,462	34,133	201,424

Table 14. - Shipment of separate fertilizer materials, East North Central States, spring season 1949

Materials	Ohio	Indiana	Illinois	Michigan	Wisconsin	Total
(Short tons)						
<u>Chemical nitrogen</u>						
Ammonium nitrate-----	968	5,667	10,447	3,097	5,317	25,496
Ammonium sulphate-----	2,167	289	356	2,464	103	5,379
Cal-Nitro-----	611	1,190	150	-	-	1,951
Cyanamid-----	1,067	894	268	304	247	2,780
Nitrate of soda-----	1,880	506	264	945	112	3,707
Uramon-----	267	327	6	328	158	1,086
<u>Organics</u>						
Dried blood-----	19	-	20	-	-	39
Dried manure, cattle-----	-	60	1,488	-	14	1,562
Dried manure, poultry-----	-	23	-	-	-	23
Dried manure, sheep-----	-	191	1,245	-	398	1,834
Dried manure, unspecified-----	676	-	766	846	-	2,288
Sewage sludge, activated-----	4,129	997	4,375	4,963	2,385	16,849
Sewage sludge, other-----	-	-	-	-	47	47
<u>Phosphate</u>						
Ammonium phosphate 11-48-----	-	-	125	-	993	1,118
Ammonium phosphate 16-20-----	-	-	640	-	-	640
Basic slag-----	-	38	-	-	-	38
Bone meal, raw-----	-	7	-	-	-	7
Bone meal-----	372	-	-	-	-	372
Bone meal, steamed-----	-	6	224	113	97	440
Calcium meta phosphate-----	-	152	38	-	313	503
Rock phosphate-----	1,964	22,155	194,385	965	3,503	222,972
Colloidal rock phosphate-----	-	2,020	473	-	1,020	3,513
Superphosphate-----18%-----	8,971	1,888	6,293	10,214	189	27,555
Superphosphate-----19%-----	-	-	-	-	8	8
Superphosphate-----20%-----	10,724	17,482	16,143	23,363	5,559	73,271
Superphosphate-----30%-----	-	-	-	78	-	78
Superphosphate-----40%-----	1,618	-	-	-	-	1,618
Superphosphate-----43%-----	-	181	-	-	9	190
Superphosphate-----44%-----	-	77	6	-	-	83
Superphosphate-----45%-----	-	1,728	4,565	615	406	7,314
Superphosphate-----46%-----	-	315	-	-	129	444
Superphosphate-----47%-----	-	210	-	-	62	272
Superphosphate-----48%-----	-	65	-	-	1	66
<u>Potash</u>						
Manure salts-----25%-----	+	-	1,999	-	124	2,123
Manure salts-----30%-----	-	-	155	-	-	155
Muriate of Potash-----50%-----	17	1,389	1,197	-	333	2,936
Muriate of potash-----60%-----	542	243	4,150	154	521	5,610
Sulphate of potash-----	-	9	-	-	1	10
Sulphate of potash, magnesia-----	-	107	530	-	50	687
Other potash-----	8	-	-	-	-	8
<u>Secondary elements</u>						
Borax-----	-	5	-	32	263	300
Copper sulphate-----	-	4	-	14	4	22
Sulphur-----	-	-	-	5	-	5
Zinc sulphate-----	-	-	-	-	2	2
Aluminum sulphate-----	-	-	3	1	1	5
Manganese sulphate-----	-	1	-	82	5	88
Total	36,000	58,226	250,311	48,583	22,374	415,494

Table 15. - Shipment of separate fertilizer materials, West North Central States, spring season 1949

Materials	Minnesota	Iowa	Missouri	Nebraska	North Dakota	South Dakota	Kansas	Total
(Short tons)								
<u>Chemical nitrogen</u>								
Ammonium nitrate-----	3,178	14,054	8,726	11,885	541	192	4,094	42,670
Ammonium phosphate-----	54	-	-	-	40	-	-	94
Ammonium phosphate-----	445	1,130	167	346	160	-	160	2,241
Ammonium sulphate-----	119	162	500	233	26	-	306	1,253
Cyanamid-----	9	109	183	158	-	-	-	776
Nitrate of soda-----	-	-	200	554	-	2	-	183
Uranon-----	26	376	-	-	-	-	10	1,168
<u>Organics</u>								
Dried manure - sheep-----	-	-	500	58	-	-	88	646
Sewage sludge - activated-----	642	58	905	210	-	-	225	2,265
Sewage sludge - other-----	1,539	793	-	-	-	-	-	332
Bone meal, raw-----	-	321	94	-	-	-	-	420
Bone meal, steamed-----	-	2	-	-	-	-	5	5
<u>Phosphate</u>								
Rock phosphate-----	1,110	8,912	26,217	637	40	80	6,083	43,079
Colloidal rock phosphate-----	400	1,111	-	-	40	150	-	1,701
Calcium meta phosphate-----	157	77	240	-	-	-	-	567
Superphosphate-----	358	9,083	-	-	8	-	-	93
Superphosphate-----	42,323	37,657	16,648	2,400	1,374	2,108	2,254	14,103
Superphosphate-----	-	-	-	1,028	1,171	220	10,190	111,328
Superphosphate-----	349	-	-	640	550	80	-	648
Superphosphate-----	1,895	-	-	-	-	-	-	525
Superphosphate-----	-	5	-	-	-	-	-	240
Superphosphate-----	5,146	5,150	6,981	130	316	110	3,394	21,587
Superphosphate-----	1,774	269	-	612	600	22	328	3,605
Superphosphate-----	2,626	143	-	57	243	-	3,374	6,443
Superphosphate-----	-	40	-	-	40	-	-	974
<u>Potash</u>								
Nature salts-----	141	4,113	1,168	-	1	-	63	1,786
Manure salts-----	-	5	-	-	-	-	-	55
Muriate of potash-----	-	252	-	-	-	-	-	252
Muriate of potash-----	-	209	778	4	17	-	33	1,141
Sulphate of potash - magnesia-----	-	7	-	-	-	-	-	7
<u>Secondary elements</u>								
Borax-----	1,515	-	173	-	-	-	-	1
L. P. - Gypsum-----	-	80	-	16	436	40	-	2,260
Sulphur-----	-	-	-	20	-	-	-	20
Manganese sulphate-----	13	-	-	-	-	-	-	13
Total	65,135	80,452	63,480	18,988	4,603	3,469	31,211	267,338

Table 16. - Shipment of rock phosphate to farms of North Central Region, fall 1945 through spring 1949

Area	1945		1946		1947		1948		1949	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
(Short tons)										
<u>East North Central States</u>										
Ohio-----	538	738	1,249	2,430	2,204	2,930	1,240	1,964		
Indiana-----	12,638	10,075	18,106	19,140	21,761	22,871	29,414	24,175		
Illinois-----	172,101	107,372	206,079	262,078	1,320,807	2,262,767	312,337	194,858		
Michigan-----	451	503	770	1,940	880	1,851	717	1,985		
Wisconsin-----	1,680	870	1,490	7,895	2,544	4,080	4,969	3,503		
Area total-----	187,408	119,558	227,694	293,483	348,196	294,499	348,677	322,485		
<u>West North Central States</u>										
Minnesota-----	1,420	445	1,283	2,196	3,609	1,500	4,2,367	1,510		
Iowa-----	3,325	4,992	6,543	10,477	14,665	11,092	517,346	10,021		
Missouri-----	1,276	2,050	2,858	4,620	7,461	11,331	17,975	26,217		
North Dakota-----	-	-	-	618	416	47	160	80		
South Dakota-----	40	-	120	680	290	170	310	230		
Nebraska-----	-	-	-	248	-	401	100	637		
Kansas-----	200	210	750	1,030	1,710	1,311	2,439	6,083		
Area total-----	6,261	7,697	11,554	19,869	28,151	25,852	40,697	644,778		
Regional total-----	193,669	127,255	239,248	313,352	376,347	320,351	389,374	271,263		

<sup>1</sup>Includes 4,858 tons of colloidal phosphate.

<sup>2</sup>Includes 3,974 tons of colloidal phosphate.

<sup>3</sup>Includes 3,513 tons of colloidal phosphate.

<sup>4</sup>Includes 300 tons of colloidal phosphate.

<sup>5</sup>Includes 2,090 tons of colloidal phosphate.

<sup>6</sup>Includes 1,701 tons of colloidal phosphate.

Table 17. - Approximate consumption of liming materials on farms of North Central States during 1948 and 1949

State <sup>1</sup>	Agricultural limestone			Burned lime			Hydrated lime			Marl			Miscellaneous materials			Total liming materials		Lime <sup>4</sup> oxides		Pounds of lime oxides per acre of Crop land <sup>5</sup> and pasture	
1949	<u>Tons</u>			<u>Tons</u>			<u>Tons</u>			<u>Tons</u>			<u>Tons</u>			<u>Tons</u>		<u>Tons</u>		<u>Pounds</u>	
Ohio <sup>6c</sup>	2,095,578	--	--	17,264	--	--	110,953	--	--	60,038	2,172,880	1,083,889	189,5	182,9	182,9	182,9	182,9	182,9	182,9	182,9	
Indiana <sup>6a</sup>	2,446,636	--	--	--	--	--	227,606	--	--	25,343	--	2,557,589	1,262,151	215,3	186,4	186,4	186,4	186,4	186,4	186,4	186,4
Michigan <sup>6a &amp; d</sup>	351,881	--	--	--	--	--	--	--	--	60,830	60,830	265,740	56,3	47,4	47,4	47,4	47,4	47,4	47,4	47,4	47,4
Illinois <sup>6d &amp; c</sup>	4,913,517	--	--	--	--	--	14,187	--	--	30,000	4,913,517	2,456,759	229,2	208,3	208,3	208,3	208,3	208,3	208,3	208,3	208,3
Wisconsin <sup>6a &amp; c</sup>	1,997,425	--	--	--	--	--	--	--	--	4,310	5,967	2,041,612	1,015,679	186,5	160,1	160,1	160,1	160,1	160,1	160,1	160,1
Minnesota <sup>6a &amp; c</sup>	359,373	--	--	--	--	--	--	--	--	--	369,650	183,581	17,5	16,4	16,4	16,4	16,4	16,4	16,4	16,4	16,4
Iowa <sup>6e</sup>	3,100,849	--	--	--	--	--	--	--	--	3,100,849	3,100,849	1,550,425	138,8	124,3	124,3	124,3	124,3	124,3	124,3	124,3	124,3
Missouri <sup>6b</sup>	2,551,798	--	--	--	--	--	--	--	--	--	2,551,798	1,275,899	183,0	151,3	151,3	151,3	151,3	151,3	151,3	151,3	151,3
Total	17,817,057	--	--	17,264	--	--	357,056	--	--	121,348	18,312,725	9,094,123	148,8	131,4	131,4	131,4	131,4	131,4	131,4	131,4	131,4
1948																					
Ohio <sup>6c</sup>	2,029,826	--	--	18,321	--	--	--	--	--	64,875	2,113,022	1,053,688	184,2	158,4	158,4	158,4	158,4	158,4	158,4	158,4	158,4
Indiana <sup>6a &amp; d</sup>	1,903,081	--	--	--	--	--	20,000	--	--	35,000	2,103,081	1,021,540	174,2	150,9	150,9	150,9	150,9	150,9	150,9	150,9	150,9
Michigan <sup>6a &amp; d</sup>	350,000	--	--	--	--	--	225,000	--	--	2,492	--	610,000	267,750	56,8	47,7	47,7	47,7	47,7	47,7	47,7	47,7
Illinois <sup>6b &amp; c</sup>	5,424,425	--	--	--	--	--	--	--	--	10,000	25,000	5,426,917	2,713,084	253,1	230,0	230,0	230,0	230,0	230,0	230,0	
Wisconsin <sup>6c &amp; d</sup>	1,926,022	--	--	--	--	--	--	--	--	4,000	8,000	1,961,022	976,511	179,3	153,9	153,9	153,9	153,9	153,9	153,9	
Minnesota <sup>6a &amp; c</sup>	230,000	--	--	--	--	--	--	--	--	--	--	242,000	119,600	11,4	10,7	10,7	10,7	10,7	10,7	10,7	
Iowa <sup>6e</sup>	2,884,107	--	--	--	--	--	--	--	--	--	--	2,884,107	1,442,053	129,1	115,6	115,6	115,6	115,6	115,6	115,6	
Missouri <sup>6b</sup>	2,563,807	--	--	--	--	--	--	--	--	--	--	2,563,807	1,282,403	183,9	152,1	152,1	152,1	152,1	152,1	152,1	
Total	17,312,268	--	--	18,321	--	--	441,492	--	--	132,875	17,904,956	8,876,629	145,3	128,2	128,2	128,2	128,2	128,2	128,2	128,2	128,2

<sup>1</sup>States not listed use little or no liming materials.

<sup>2</sup>Agricultural limestone includes materials used in fertilizer mixtures and all the various grades of limestone which are used for direct application to the soil. These vary from the finely ground materials, all of which pass through a 20-mesh sieve in the East, to the less finely ground materials customarily used in other areas.

<sup>3</sup>Consists of ground mollusk and egg shells, paper and sugar mill refuse, slag, lead mine chats, and carbide refuse.

<sup>4</sup>Computed on the following basis: 50% for agricultural limestone; 88% for burned lime; 70% for hydrated lime; 40% for commercial marl and miscellaneous materials; and 35% for farm-dug marl.

<sup>5</sup>Crop land acreage consists of pasture land plowed within 7 years. (1945 Census) The above tonnage figures were obtained (a) from Agricultural Conservation Program records; (b) by County Survey; (c) by producer survey; (d) estimated; and/or (e) Farm Census.

Source: National Lime Association and the Agricultural Limestone Institute, Washington, D.C.

Table 18. - Wholesale shipment of fertilizer mixtures and separate materials, by regional cooperatives, North Central States, by seasons and kinds, calendar years 1940-49<sup>1</sup>

Year	Season	Region						Regional total		Total tonnage	
		East North Central			West North Central						
		Kind of fertilizer		Total	Kind of fertilizer		Total	Kind of fertilizer			
		Mixed	Separate		Mixed	Separate		Mixed	Separate		
(Short tons)											
1940-----	Spring Fall	63,035	5,457	68,492	488	163	651	63,523	5,620	69,143	
		40,871	3,708	44,579	263	88	351	41,134	3,796	44,930	
1941-----	Total	103,906	9,165	113,071	751	251	1,002	104,657	9,416	114,073	
		60,229	5,460	65,689	971	285	1,256	61,200	5,745	66,945	
1942-----	Spring Fall	41,926	2,889	44,815	523	190	713	42,449	3,079	45,528	
		102,155	8,349	110,504	1,494	475	1,969	103,649	8,824	112,473	
1943-----	Spring Fall	82,109	7,386	89,495	1,261	559	1,820	83,370	7,945	91,315	
		35,152	3,815	38,967	1,225	432	1,657	36,377	4,247	40,624	
1944-----	Total	117,261	11,201	128,462	2,486	991	3,477	119,747	12,192	131,939	
		93,807	8,527	102,334	2,253	660	2,913	96,060	9,187	105,247	
1945-----	Spring Fall	68,671	3,515	72,186	1,284	350	1,634	69,955	3,865	73,820	
		162,478	12,042	174,520	3,537	1,010	4,547	166,015	13,052	179,067	
1946-----	Spring Fall	110,676	9,295	119,971	9,968	6,343	16,311	120,644	15,638	136,282	
		69,391	5,092	74,483	6,682	4,418	11,100	76,073	9,510	85,583	
1947-----	Total	180,067	14,387	194,454	16,650	10,761	27,411	196,717	25,148	221,865	
		120,810	8,533	129,343	10,656	5,104	15,760	131,466	13,637	145,103	
1948-----	Spring Fall	73,248	15,662	88,910	7,137	3,644	10,781	80,385	19,306	99,691	
		194,058	24,195	218,253	17,793	8,748	26,541	211,851	32,943	244,794	
1949-----	Spring Fall	145,125	24,729	169,854	21,155	9,463	30,618	166,280	34,192	200,472	
		86,313	18,219	104,532	15,069	5,353	20,422	101,382	23,572	124,954	
1947-----	Total	231,438	42,948	274,386	36,224	14,816	51,040	267,662	57,764	325,426	
		156,222	35,521	191,743	61,229	20,541	81,770	217,451	56,062	273,513	
1948-----	Spring Fall	99,782	25,925	125,707	37,181	19,400	56,581	136,963	45,325	182,288	
		256,004	61,446	317,450	98,410	39,941	138,351	354,414	101,387	455,801	
1949-----	Total	177,248	39,691	216,939	107,137	41,878	149,015	284,385	81,569	365,954	
		133,265	27,929	161,194	61,072	24,561	85,633	194,337	52,490	246,827	
1949-----	Total	310,513	67,620	378,133	168,209	66,439	234,648	478,722	134,059	612,781	
		221,048	61,588	282,636	101,091	48,414	149,505	322,139	110,002	432,141	
1949-----	Spring Fall	132,931	39,634	172,565	63,955	20,989	84,944	196,886	60,623	257,509	
		353,979	101,222	455,201	165,046	69,403	234,449	519,025	170,625	689,650	

<sup>1</sup>Rock phosphate excluded.

Table 19. - Percent change in wholesale shipment of fertilizer mixtures and separate materials by cooperatives, North Central States, 1940-49<sup>1</sup>

Year	Area and Region	Spring	Fall	Calendar year
		Percent change	Percent change	Percent change
1941	East North Central	-4.3	0.5	-2.3
c/w	West North Central	92.9	103.1	96.5
1940	North Central	-3.3	1.3	-1.4
1942	East North Central	36.2	-15.0	16.3
c/w	West North Central	44.9	132.4	76.6
1941	North Central	36.4	-12.1	17.3
1943	East North Central	14.3	85.2	35.9
c/w	West North Central	60.1	-1.4	30.1
1942	North Central	15.3	81.7	35.7
1944	East North Central	17.2	3.2	11.4
c/w	West North Central	459.9	579.3	502.8
1943	North Central	29.5	15.9	23.9
1945	East North Central	7.8	19.4	12.2
c/w	West North Central	-3.5	-3.0	-3.3
1944	North Central	6.5	16.5	10.3
1946	East North Central	31.3	17.8	25.7
c/w	West North Central	94.3	89.4	92.3
1945	North Central	38.2	16.5	32.9
1947	East North Central	12.9	20.3	15.7
c/w	West North Central	167.1	177.1	171.1
1946	North Central	36.4	45.9	40.1
1948	East North Central	13.1	28.2	19.1
c/w	West North Central	82.2	51.3	69.6
1947	North Central	33.8	35.4	34.4
1949	East North Central	30.3	7.1	20.4
c/w	West North Central	0.3	-0.8	-0.1
1948	North Central	18.1	4.3	12.5
1949	East North Central	312.7	287.1	302.6
c/w	West North Central	1,129.7	2,320.1	2,239.8
1940	North Central	525.0	473.1	504.6

<sup>1</sup> Does not include Rock Phosphate.

East North Central - Ohio, Indiana, Illinois, Michigan, and Wisconsin.

West North Central - Minnesota, Iowa, Missouri, South Dakota, North Dakota, and Kansas.

North Central Region - Includes above two areas.

Table 20. - Monthly wholesale shipment of fertilizer mixtures and separate materials by regional cooperatives as percent of yearly shipments, North Central States 1949<sup>1</sup>

Month	East North Central <sup>2</sup>			West North Central <sup>3</sup>			North Central Region		
	Mixed	Separate	Total	Mixed	Separate	Total	Mixed	Separate	Total
Percent									
January-----	10	6	9	9	8	9	10	7	9
February-----	11	8	10	11	14	12	11	10	11
March-----	13	17	13	16	14	15	14	15	14
April-----	14	16	15	23	27	24	17	21	18
May-----	11	9	11	9	6	8	10	8	10
June-----	3	6	3	2	3	3	3	5	3
First 6 months-----	62	62	61	70	72	71	65	66	65
July-----	2	6	3	2	2	2	2	4	2
August-----	9	9	9	4	4	3	7	7	7
September-----	15	10	14	9	5	8	13	8	12
October-----	6	5	6	8	8	8	7	6	7
November-----	2	4	3	3	3	3	2	4	3
December-----	4	4	4	4	6	5	4	5	4
Last 6 months-----	38	38	39	30	28	29	35	34	35
Total Percent-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Tons-----	353,979	101,222	455,201	165,046	69,403	234,449	519,025	170,625	689,650

<sup>1</sup>Rock phosphate excluded.

<sup>2</sup>Ohio, Indiana, Illinois, Michigan, and Wisconsin.

<sup>3</sup>Minnesota, Iowa, Missouri, South Dakota, Nebraska, and Kansas.

Table 21. - Wholesale shipment of separate fertilizer materials by regional cooperatives, North Central States, 1949<sup>1</sup>

Season and Area	Superphosphate			Nitrogen <sup>2</sup>			Potash			Minor elements and miscellaneous		
	Total	Tons	Percent	Total	Tons	Percent	Total	Tons	Percent	Total	Tons	Total
Spring												
East North Central												
Ohio	2,704	3.8	16.446	-	1,061	2,451	8.9	72	0.7	72	1	0.1
Indiana	17,382	24.3	5,914	-	936	2,516	9.1	3,269	32.1	2,562	203	19.6
Illinois	10,319	14.4	3,960	100	4,405	5,517	20.0	4,464	43.8	4,464	-	-
Michigan	6,040	8.4	1,311	-	1,980	2,656	9.6	543	5.3	543	39	3.8
Wisconsin	1,908	2.6	-	597	749	2.7	605	5.9	411	194	150	14.4
Total	38,353	53.5	29,274	100	8,979	13,689	50.3	8,953	87.8	8,052	901	393
West North Central												
Minnesota	15,167	21.2	3,754	-	11,413	2,495	9.0	368	3.6	250	118	64.5
Iowa	7,848	11.0	4,329	-	3,119	3,362	12.2	261	2.6	183	78	62.1
Missouri	8,320	11.6	3,960	-	4,360	3,713	13.4	370	3.6	370	-	-
North Dakota	309	0.4	197	-	112	32	0.1	9	0.1	9	-	-
South Dakota	291	0.4	200	-	91	86	0.3	23	0.2	23	-	-
Nebraska	282	0.4	242	-	40	3,641	13.2	12	0.1	12	-	-
Kansas	1,089	1.5	823	-	266	421	1.5	200	2.0	200	-	-
Total	33,306	46.5	13,505	-	19,801	13,750	49.7	1,243	12.2	1,047	196	645
Regional total	71,659	100.0	42,779	100	28,780	27,639	100.0	10,196	100.0	9,099	1,097	1,038
Fall												
East North Central												
Ohio	1,725	4.4	1,220	-	505	2,020	14.9	112	1.6	112	-	2.3
Indiana	14,470	36.9	13,650	-	820	1,533	11.4	641	8.9	574	67	80
Illinois	6,672	17.0	4,783	-	1,889	1,335	12.8	5,313	73.6	4,803	510	10.8
Michigan	916	2.3	838	78	-	554	10.6	82	1.1	82	-	-
Wisconsin	1,350	3.4	786	-	-	945	7.0	115	1.6	115	-	388
Total East North Central	25,133	64.0	21,287	78	3,768	7,668	56.7	6,263	86.8	5,686	577	470
West North Central												
Minnesota	5,437	13.9	1,763	-	3,674	806	6.0	267	3.7	96	171	36.5
Iowa	3,140	7.9	1,276	-	1,834	2,096	15.5	86	1.2	86	-	-
Missouri	5,037	12.8	1,381	-	3,656	2,717	20.1	564	7.8	564	-	-
North Dakota	168	0.4	101	-	67	23	0.1	-	-	-	-	-
South Dakota	145	0.4	82	-	63	20	0.1	15	0.2	15	-	-
Nebraska	144	0.4	126	-	18	184	1.4	22	0.3	22	-	-
Kansas	92	0.2	65	-	27	19	0.1	-	-	-	-	-
Total West North Central	14,133	36.0	4,794	-	9,339	5,865	43.3	954	13.2	783	171	270
Total East and West North Central	39,266	100.0	26,081	78	13,107	13,533	100.0	7,217	100.0	6,469	748	100.0
Total spring and fall	110,925	64.6	68,860	178	41,887	41,172	57.1	17,413	58.6	15,568	1,845	1,778
Percent for spring												
Percent for fall												

<sup>1</sup>Rock phosphate excluded.<sup>2</sup>Ammonium nitrate of soda, ammonium sulphate, cyanamid, ammonium nitrate.<sup>3</sup>Includes 723 tons of lime shipped in Minnesota; also includes borax, copper sulphate, bone meal, manganese sulphate, magnesium sulphate, natural organics.

Table 22. - Weighted average analysis of all fertilizer mixtures shipped in North Central States compared with shipments of regional cooperatives, spring season, 1949

Mixtures according to type of distributor	Average analysis			Total	
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Tons	Percent
<b>Cooperatives<sup>1</sup></b>					
P.K.	-	21.52	16.00	50,329	17.5
N.P.K.	3.32	13.50	10.47	225,500	78.4
N.P.	5.86	19.04	-	11,798	4.1
All mixtures-----	2.34	15.13	11.00	287,627	100.0
 <b>All Shippers<sup>2</sup></b>					
P.K.	-	14.94	14.75	268,298	12.1
N.P.K.	3.01	12.15	9.52	1,892,933	85.0
N.P.	4.60	16.90	-	65,403	2.9
All mixtures-----	2.69	12.63	9.87	2,226,634	100.0

<sup>1</sup>Data for cooperative shipments are based on 97 percent of mixtures reported.  
<sup>2</sup>Shipments based on U.S. Department of Agriculture figures, which also include cooperative tonnages.

Table 23. - Weighted average analysis of fertilizer mixtures shipped, East North Central States, spring season 1949

State	Number of grades	Mixtures	Average analysis			Short tons	Percent of tonnage
			N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O		
Ohio-----	6	P.K.	-	14.38	12.72	33,875	6.3
	27	N.P.K.	2.82	12.20	8.87	506,014	93.7
	-	N.P.	-	-	-	-	-
	33					539,889	100.0
Indiana-----	8	P.K.	-	12.86	15.59	68,413	14.6
	43	N.P.K.	2.83	12.08	9.96	401,444	85.4
	1	N.P.	4.00	16.00	-	4	-
	52					469,861	100.0
Illinois-----	7	P.K.	-	13.10	13.74	25,984	11.0
	24	N.P.K.	3.24	11.78	10.80	209,184	88.9
	3	N.P.	5.57	15.98	-	219	0.1
	34					235,387	100.0
Michigan-----	8	P.K.	-	14.31	16.55	28,097	10.8
	20	N.P.K.	2.70	12.61	9.12	231,366	89.0
	1	N.P.	4.00	16.00	-	541	0.2
	29					260,004	100.0
Wisconsin-----	11	P.K.	-	16.51	13.88	70,198	27.1
	28	N.P.K.	3.11	10.10	11.22	188,291	72.8
	3	N.P.	9.02	31.95	-	149	0.1
	42					258,638	100.0
Area-----		P.K.	-	14.43	14.54	226,567	12.8
		N.P.K.	2.90	11.92	9.74	1,536,299	87.1
		N.P.	5.20	18.60	-	913	0.1
						1,763,779	100.0

Table 24. - Weighted average analysis of fertilizer mixtures shipped,  
West North Central States, spring season 1949

State	Number of grades	Mixtures	Average analysis			Short tons	Percent of tonnage
			N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O		
Minnesota-----	10	P.K. N.P.K. N.P.	-	19.69	16.10	23,576	22.8
	34		3.67	16.92	11.08	77,775	75.4
	6		5.97	19.97	-	1,859	1.8
	50					103,210	100.0
Iowa-----	6	P.K. N.P.K. N.P.	-	12.30	20.97	8,281	4.8
	28		3.23	12.99	9.26	116,487	68.1
	9		4.30	16.40	-	46,256	27.1
	43					171,024	100.0
Missouri-----	5	P.K. N.P.K. N.P.	-	15.23	11.05	8,168	5.2
	14		3.45	11.61	6.84	145,258	93.0
	2		5.81	17.21	-	2,750	1.8
	21					156,176	100.0
North Dakota--	7	P.K. N.P.K. N.P.	-	30.92	10.95	1,370	18.0
	14		3.39	16.79	10.72	5,749	75.6
	5		5.78	24.93	-	483	6.4
	26					7,602	100.0
South Dakota--	-	P.K. N.P.K. N.P.	-	-	-	-	-
	12		4.43	12.34	5.56	609	20.7
	8		4.28	16.32	-	2,338	79.3
	20					2,947	100.0
Nebraska-----	1	P.K. N.P.K. N.P.	-	9.00	29.00	28	0.4
	15		8.08	16.82	7.78	1,921	30.3
	5		6.46	20.07	-	4,396	69.3
	21					6,345	100.0
Kansas-----	5	P.K. N.P.K. N.P.	-	19.12	9.75	308	2.0
	19		4.22	11.15	4.73	8,835	56.8
	6		4.70	16.65	-	6,408	41.2
	30					15,551	100.0
Area-----		P.K. N.P.K. N.P.	-	17.71	15.87	41,731	9.0
			3.47	13.12	8.57	356,634	77.1
			4.61	16.87	-	64,490	13.9
						462,855	100.0

Table 25. - Combined index numbers of prices of fertilizer materials, farm products, and all commodities

Farm prices <sup>1</sup>	Prices paid by farmers for commodities bought <sup>1</sup>	Wholesale prices of all commodities <sup>2</sup>	Fertilizer material <sup>3</sup>	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash <sup>4</sup>
1940-100	122	115	80	52	114	96	77
1941-124	131	127	86	56	130	102	77
1942-159	152	144	93	57	161	112	77
1943-192	167	151	94	57	160	117	77
1944-195	176	152	96	57	174	120	76
1945-202	180	154	97	57	175	121	76
1946-233	202	177	107	62	240	125	75
1947-278	246	222	130	74	362	139	72
1948-287	264	241	134	89	314	143	70
1949-268	260	233	136	97	313	144	72
January-258	257	231	136	99	309	144	72
March-261	258	231	134	99	290	144	72
April-260	258	229	134	99	291	144	72
May-256	257	227	134	99	293	144	72
June-252	257	223	134	99	304	144	65
July-249	256	225	140	100	349	144	68
August-245	254	222	143	100	372	144	68
September-249	253	225	138	100	334	144	68
October-243	25*	222	138	98	331	144	72
November-239	250	221	136	96	321	144	72
December-236	251	220	136	96	317	144	72

<sup>1</sup>U. S. Department of Agriculture figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

<sup>2</sup>Department of Labor index converted to 1910-14 base. These indexes are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

<sup>3</sup>The index numbers of prices of fertilizer materials are complete since 1897. The weighted average price for potash is lower than the annual average because since 1926 over 90 percent of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12 percent. Applied to a unit of potash, a price slightly above \$1.71 per unit K<sub>2</sub>O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.

Source: Better Crops With Plant Food, January 1950.

Table 26. - Annual capacity of plants manufacturing ordinary superphosphate and (or) wet-mixed base in the continental United States, calendar years 1940, 1945, 1947, and 1950<sup>1</sup>

Year	Number of plants	Short tons	
		Material <sup>2</sup>	Available P <sub>2</sub> O <sub>5</sub> <sup>3</sup>
1940 <sup>4</sup> -----	145	8,399,378	1,511,888
1945 <sup>5</sup> -----	159	11,486,625	2,067,503
1947 <sup>6</sup> -----	176	13,246,847	2,384,433
1950 <sup>7</sup> -----	200	14,334,147	2,580,147

<sup>1</sup>The data relate only to plants that operated or were expected to operate in the years indicated.

<sup>2</sup>Basis 18 percent available P<sub>2</sub>O<sub>5</sub>. The assumptions on which the estimates are based are not uniform throughout; those for the years 1940, 1945, and 1947 are summarized by Jacob (1948).

<sup>3</sup>Total P<sub>2</sub>O<sub>5</sub> minus P<sub>2</sub>O<sub>5</sub> insoluble in neutral ammonium citrate solution.

<sup>4</sup>Data from Jacob (1942).

<sup>5</sup>Data from W. R. Corey U. S. War Production Board, Chemicals Bureau, Inorganics Branch, WPB-3191, July 18, 1945.

<sup>6</sup>Data from Jacob (1948).

<sup>7</sup>As of July 15.

Compiled by: K. D. Jacob, Agricultural Research Administration, U. S. Department of Agriculture.

Table 27. - Regional distribution of plants manufacturing ordinary Superphosphate and (or) wet-mixed base in the continental United States, calendar years 1940, 1945, 1947, and 1950<sup>1</sup>

Region <sup>2</sup>	1940 <sup>3</sup>	1945 <sup>4</sup>	1947 <sup>5</sup>	1950 <sup>6</sup>
New England-----	3	4	4	4
Middle Atlantic-----	15	14	14	14
South Atlantic-----	59	68	71	72
East North Central-----	28	30	36	45
West North Central-----	0	2	6	11
East South Central-----	30	29	32	36
West South Central-----	8	9	10	13
Mountain-----	0	1	1	2
Pacific-----	2	2	2	3
United States <sup>7</sup> -----	145	159	176	200

<sup>1</sup>The data relate only to plants that operated or were expected to operate in the years indicated.

<sup>2</sup>See Table X for the States comprising the regions.

<sup>3</sup>Data from Jacob (1942).

<sup>4</sup>Data from U. S. Department of Commerce, Bureau of the Census Facts for Industry, Series MI9D-26, Superphosphate - February 1946, Apr. 10, 1946.

<sup>5</sup>Data from Jacob (1948).

<sup>6</sup>As of July 15.

<sup>7</sup>In addition, there was one plant in the Hawaiis and one in Puerto Rico in each of the years.

Compiled by: K. D. Jacob, Agricultural Research Administration, U. S. Department of Agriculture.

Table 28. - *Ordinary superphosphate plants operated by individual companies in the continental United States, as of July 15, 1950.*

Number of companies <sup>1</sup>	Number of plants	
	Operated by each company	Total
4	15-27 <sup>2</sup>	78
2	10-11	21
2	4-5	9
4	3	12
11	2	22
<b>58</b>	<b>1</b>	<b>58</b>
<b>81<sup>3</sup></b>	<b>1-27</b>	<b>200</b>

<sup>1</sup>Companies operating under different names but having the same officials are included as one company, as are companies known to be subsidiaries of, or controlled wholly or in part by, another company; includes wet-mixed base.

<sup>2</sup>15, 17, 19, and 27 plants, respectively.

<sup>3</sup>Includes 13 farmer cooperatives that operate 15 plants--3 in Missouri, 2 each in Georgia and Indiana, and 1 each in Maryland, Ohio, Illinois, Michigan, Wisconsin, Kentucky, Mississippi, and Texas.

Compiled by: K. D. Jacob, Agricultural Research Administration, U. S. Department of Agriculture.

Table 29. - *Classification of facilities for manufacture of ordinary superphosphate and (or) wet-mixed base in the continental United States, as of July 15, 1950*

Plants	Number
<b>Total-----</b>	<b>200</b>
Having coexisting facilities for manufacture of sulfuric acid <sup>1</sup> -----	90 <sup>2</sup>
Having mechanical den system <sup>3</sup> -----	111 <sup>4</sup>
Having coexisting facilities for grinding phosphate rock-----	135 <sup>5</sup>

<sup>1</sup>Box-chamber, Mills-Packard, and contact facilities, principally the first.

<sup>2</sup>Includes 20 plants that have contact facilities.

<sup>3</sup>Continuous (Broadfield, Sackett, and other types, principally the first) and non-continuous (Sturtevant, Svenska, and Forbis, principally the first) systems.

<sup>4</sup>Include 16 plants that have continuous den systems.

<sup>5</sup>Includes 5 plants that have coexisting grinding facilities but purchase ready-ground rock.

Compiled by: K. D. Jacob, Agricultural Research Administration, U. S. Department of Agriculture.

Table 30. - Additions<sup>1</sup> to fertilizer production capacity in the North Central States

State	Completed between July 1, 1945, and December 31, 1947		Planned for completion before January 1, 1949	
	Super-phosphate	Mixed fertilizer	Super phosphate	Mixed fertilizer
	<u>Tons</u>	<u>Tons</u>	<u>Tons</u>	<u>Tons</u>
Ohio, Indiana and Michigan-----	173,000	142,000	55,000	42,000
Illinois-----	290,000	52,000	115,000	140,000
Wisconsin-----	75,000	173,000	75,000	45,000
Minnesota and North Dakota-----	-	91,000	-	67,500
Iowa-----	80,000	250,000	105,000	45,000
Missouri, Nebraska and Kansas-----	100,000	69,500	70,000	18,000
North Central Region-----	708,000	777,500	420,000	357,500

<sup>1</sup>Includes both new plants and enlargements of old ones. The total new capacity would not be the sum of the new superphosphate and mixed fertilizer capacities, because part of the superphosphate would be used in making the latter. The total new production capacity making adjustments for such duplication would be about 1,170,000 tons already installed and 540,000 tons being built or planned for early erection.

NOTE: The capacity to manufacture mixed fertilizers and superphosphate in 1945 before any of the additions listed above is estimated at 2,350,000 short tons.

Compiled by: A. L. Mehring, Agricultural Research Administration, U. S. Department of Agriculture.

Table 31. - 1951 acreage guide for corn as established by U. S. Department of Agriculture for North Central States and for United States

State	Acreage (Planted)				Percent 1951 guide is of:		
	1942-46 average	1949	1950	1951 guide	1942-46 average	1949	1950
<u>Thousands</u>							
Ohio-----	3,510	3,627	3,384	3,700	105	102	109
Indiana-----	4,391	4,818	4,345	4,820	110	100	111
Illinois-----	8,543	9,280	8,300	9,300	109	100	112
Michigan-----	1,729	1,798	1,690	1,820	105	101	108
Wisconsin-----	2,588	2,621	2,595	2,700	104	103	104
Minnesota-----	5,545	5,682	5,152	5,700	103	100	111
Iowa-----	10,732	11,493	9,905	11,500	107	100	116
Missouri-----	4,538	4,396	4,200	4,500	99	102	107
North Dakota-----	1,226	1,250	1,350	1,350	110	108	100
South Dakota-----	3,879	4,101	3,855	4,100	106	100	106
Nebraska-----	8,260	7,438	6,843	7,950	96	107	116
Kansas-----	3,346	2,598	2,676	3,000	90	115	112
United States-----	91,630	88,192	84,370	<sup>1</sup> 90,002	98	102	107

<sup>1</sup>Summation of adjusted State guides.

Table 32. - 1951 acreage guide for oats as established by U. S. Department of Agriculture for North Central States and for United States

State	Acreage (planted)				Percent 1951 guide is of:		
	1942-46 average	1949	1950	1951 guide	1942-46 average	1949	1950
<i>Thousands</i>				<i>Percent</i>			
Ohio-----	1,222	1,373	1,181	1,150	94	84	97
Indiana-----	1,454	1,502	1,457	1,400	96	93	96
Illinois-----	3,532	3,881	3,959	3,600	102	93	91
Michigan-----	1,462	1,614	1,501	1,475	101	91	98
Wisconsin-----	2,790	3,030	3,000	3,000	108	99	100
Minnesota-----	4,837	5,027	5,168	4,800	99	95	93
Iowa-----	5,313	6,417	6,555	5,900	111	92	90
Missouri-----	2,224	2,016	2,016	1,950	88	97	97
North Dakota-----	2,560	1,902	2,225	2,000	78	105	90
South Dakota-----	3,004	3,102	3,474	3,100	103	100	89
Nebraska-----	2,343	2,489	2,862	2,450	105	98	86
Kansas-----	1,743	1,034	1,520	1,350	77	131	89
United States-----	44,545	44,387	46,642	<sup>1</sup> 43,727	98	99	94

<sup>1</sup>Summation of adjusted State guides.

Table 33. - 1951 acreage guide for barley as established by U. S. Department of Agriculture for North Central States and for United States

State	Acreage (planted)				Percent 1951 guide is of:		
	1942-46 average	1949	1950	1951 guide	1942-46 average	1949	1950
<i>Thousands</i>				<i>Percent</i>			
Ohio-----	37	17	27	20	54	118	74
Indiana-----	67	23	27	25	37	109	93
Illinois-----	85	44	50	40	47	91	80
Michigan-----	162	129	116	150	93	116	129
Wisconsin-----	257	189	217	225	88	119	104
Minnesota-----	1,026	1,097	1,283	1,200	117	109	94
Iowa-----	51	28	60	30	59	107	50
Missouri-----	149	100	100	100	67	100	100
North Dakota-----	2,548	1,852	2,148	2,275	89	123	106
South Dakota-----	1,927	1,219	1,256	1,400	73	115	111
Nebraska-----	1,318	381	411	410	31	108	100
Kansas-----	1,039	266	636	500	48	188	79
United States-----	14,948	11,188	13,235	<sup>1</sup> 13,242	89	118	100

<sup>1</sup>Summation of adjusted State guides.

Table 34. - 1951 acreage guide for all wheat as established by U. S. Department of Agriculture for North Central States and for United States

State	Acreage (planted)				Percent 1951 guide is of:		
	1942-46 average	1949	1950	1951 <sup>1</sup> guide	1942-46 average	1949	1950
<u>Thousands</u>							<u>Percent</u>
Ohio-----	1,848	2,377	2,172	2,150	116	90	99
Indiana-----	1,294	1,757	1,564	1,627	126	93	104
Illinois-----	1,281	1,952	1,520	1,827	143	94	120
Michigan-----	840	1,303	1,173	1,232	147	95	105
Wisconsin-----	75	115	90	103	137	90	114
Minnesota-----	1,233	1,300	967	1,226	99	94	127
Iowa-----	169	410	277	269	159	66	97
Missouri-----	1,255	2,125	1,661	1,744	139	82	105
North Dakota-----	9,331	11,040	8,915	11,000	118	100	123
South Dakota-----	3,250	4,368	3,528	4,017	124	92	114
Nebraska-----	3,507	4,686	4,107	4,458	127	95	109
Kansas-----	12,593	16,244	13,807	14,497	115	89	105
United States-----	<sup>2</sup> 63,167	84,662	71,396	77,800	123	92	109

<sup>1</sup> Includes Winter Wheat seeded as of December 11, 1950, plus Spring Wheat guides.

<sup>2</sup> Includes Maine.

Table 35. - 1951 acreage guide for soybeans for beans as established by U. S. Department of Agriculture for North Central States and for United States

State	Acreage (harvested)				Percent 1951 guide is of:		
	1942-46 average	1949	1950	1951 guide	1942-46 average	1949	1950
<u>Thousands</u>							<u>Percent</u>
Ohio-----	1,097	858	1,056	1,100	100	128	104
Indiana-----	1,407	1,442	1,591	1,600	114	111	101
Illinois-----	3,445	3,287	3,948	3,750	109	114	95
Michigan-----	114	66	117	130	114	197	111
Wisconsin-----	47	15	24	30	64	200	125
Minnesota-----	368	709	1,057	1,100	299	155	104
Iowa-----	1,812	1,340	1,921	1,900	105	142	99
Missouri-----	613	857	1,191	1,160	189	135	97
North Dakota-----	5	20	41	40	800	200	98
South Dakota-----	15	29	66	50	333	172	76
Nebraska-----	34	22	46	50	147	23	109
Kansas-----	215	237	359	363	169	153	101
United States-----	10,187	10,156	13,291	<sup>1</sup> 13,013	128	128	98

NOTE: Includes only those states with guides.

<sup>1</sup> Summation of adjusted State guides.

Table 36. - *Origin of fertilizer materials received by one East North Central Cooperative mixing and acidulating facility, 1949*

<u>MATERIAL</u>	<u>ORIGIN</u>
Phosphate rock-----	Agricola, Fla.
Nitrate of soda-----	Baltimore, Md.
Quick lime-----	Carey, Ohio
Potash-----	Carlsbad, N. Mex.
Fuller's earth-----	Chicago, Ill.
Superphosphate-----	Chicago, Ill.
Sulphate of ammonia-----	Gary, Ind.
Quick lime-----	Genoa, Ohio
Neutral phosphate-----	Grasselli, Ind.
Ground limestone-----	Greencastle, Ind.
Sulphate of ammonia-----	Hamilton, Ohio
Nitrogen fertilizer solution-----	Hopewell, Va.
Liquid ammonia-----	Indiana Harbor, Ind.
Sulphate of ammonia-----	Indianapolis, Ind.
Nitrogen fertilizer solution-----	Kenova, West Va.
Ammonium nitrate-----	Sheffield, Ala.
Acid phosphate-----	Mt. Pleasant, Tenn.
Cyanamid-----	Niagara Falls, N.Y.
Nitrate of soda-----	Norfolk, Va.
Fuller's earth-----	Philadelphia, Pa.
Fertilizer compound-----	Port Robinson, Ontario
Lime (hydrated)-----	Salem, Ind.
Superphosphate-----	Sheffield, Ala.
Acid phosphate-----	Siglo, Tenn.
Nitrogen fertilizer solution-----	South Point, Ohio
Acid phosphate-----	Tampa, Fla.
Manufactured fertilizer-----	Tampa, Fla.
Potash-----	Trona, Calif.
Superphosphate-----	Wales, Tenn.
Potash-----	Wendover, Utah
Fuller's earth-----	Whiting, Ind.

